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v.56 #3

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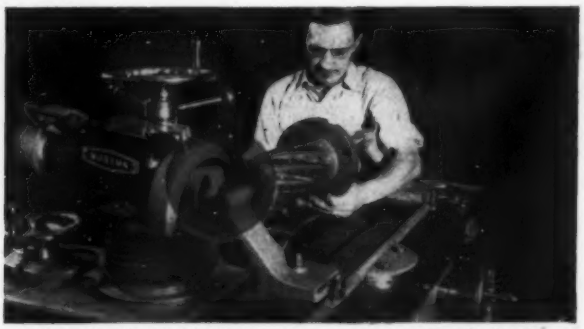

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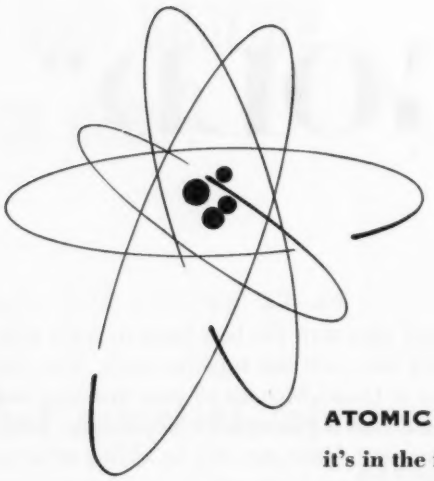

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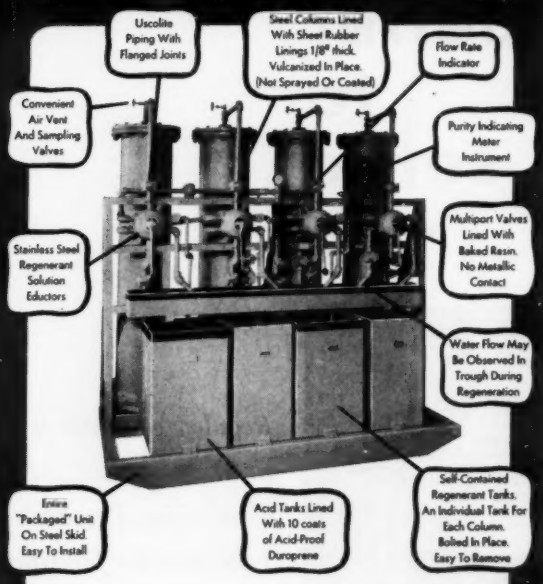
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THE TABULAR VIEW

Mentor's Monition. – The Review is happy to bring to its readers the seventh Arthur Dehon Little Memorial Lecture entitled "Psychology, the Machine, and Society" (page 141) by LEONARD CARMICHAEL, Secretary of the Smithsonian Institution. In a study of man's relation to the technological era which he has built up, Dr. Carmichael clearly points out that although science has "given great sections of modern man a high standard of living and an opportunity to provide themselves a life of health and comfort," progress in understanding man's inborn and acquired make-up is important for a valid understanding of modern society and technology. To this end Dr. Carmichael believes that "education fitted to the aptitudes of each individual is a most promising tool." As a psychologist interested in applying the methods of his science to the problems of behavior, Dr. Carmichael has directed his talents over a wide range of investigation and endeavor since Harvard University awarded him the degree of doctor of philosophy in 1924. After a year in Germany as a Sheldon Traveling Fellow, he joined the Department of Psychology at Princeton University. He was elected to the chairmanship of the Department of Psychology at Brown University, served two years as Dean of the Faculty of the University of Rochester, and returned to Tufts College as president in 1938. He became secretary of the Smithsonian Institution on January 1, 1953.

Ill-fated Interference. – In their attempts to cover a great detail of material in reasonably compact form, historians frequently neglect the role which epidemics and disease have played in changing the course of history. But ill-fated interference from yellow fever was a significant factor in changing the map of the United States a century and a half ago, as JAMES A. TOBEY, '15, reminds us (page 145). Dr. Tobey received the S.B. and Dr.P.H. degrees from M.I.T. in 1916 and 1927 respectively, the LL.B. degree from Washington Law School in 1922, and the M.S. degree from the American University in 1923. He is author of *Public Health Law* and has been a frequent contributor to The Review. Dr. Tobey has also served as a colonel in the Army's Medical Service in Texas.

Tile Technology. – This issue brings to Review readers (page 147) the first of a two-part article on "Decorative Tiles – Their Place in Ceramic Art" by E. STANLEY WIRES, '07. Much of the world's history, art, technology, and culture may be traced through the tile fragments coming to us from the world's earlier civilizations. Mr. Wires was treasurer and manager of the E. Stanley Wires Company, Inc., in Boston between 1908 and 1944, and has been New England sales manager for the Cambridge Tile Manufacturing Company from 1945 to 1952. He is past director and vice-president of the Tile and Mantel Contractors Association of America, and past chairman of the Tile Industry Research Bureau, Department of Ceramics, Rutgers University.

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MAIL RETURNS

Reaction to "Suburban Life"

[Seldom – if ever – has an article in The Review evoked as much comment as "An Appraisal of Suburban Middle Class Life" by Julian A. Joffe, '24, in the November, 1953, issue. As a result of Mr. Joffe's article, The Review Office is already in receipt of a second manuscript on suburban living, and – by long-distance telephone – still another manuscript refuting Mr. Joffe's views has been proposed. But perhaps the fact that the pages of The Review are thoroughly read is best attested by the following extracts from letters in which Alumni comment on Mr. Joffe's observations. – Ed.]

☆ ☆ ☆

FROM VINCENT L. GALLAGHER, '12:

Mr. Joffe talks like a man who didn't make the country club. As for you, Mr. Editor, please give us more of the Moreell type of copy and less – no, none – of the Joffe type.

New York 6, N. Y.

☆ ☆ ☆

FROM AUGUSTUS B. KINZEL, '21:

This refers to the article entitled "An Appraisal of Suburban Middle Class Life" printed in the November issue of The Review. I cannot understand why you publish this in The Review or why you dignify it by calling it a study. The observations pertain to a very limited number of parvenus who are just as prevalent in the city as they are in the suburbs. Certainly it is full of general statements without any supporting evidence, the implication being that the statements refer to the great majority of suburbanites in a particular income group. A few facts which could be readily obtained from the Association of University Women and the League of Women Voters will completely dispel the thought that Julian A. Joffe is dealing with such a majority.

New York 17, N. Y.

☆ ☆ ☆

FROM J. BRYANT WILLIAMS, JR., '47:

I enjoy the articles in The Review. Julian A. Joffe's "An Appraisal of Suburban Middle Class Life" (November, 1953) presented an interesting view of life today.

Greenwich, Conn.

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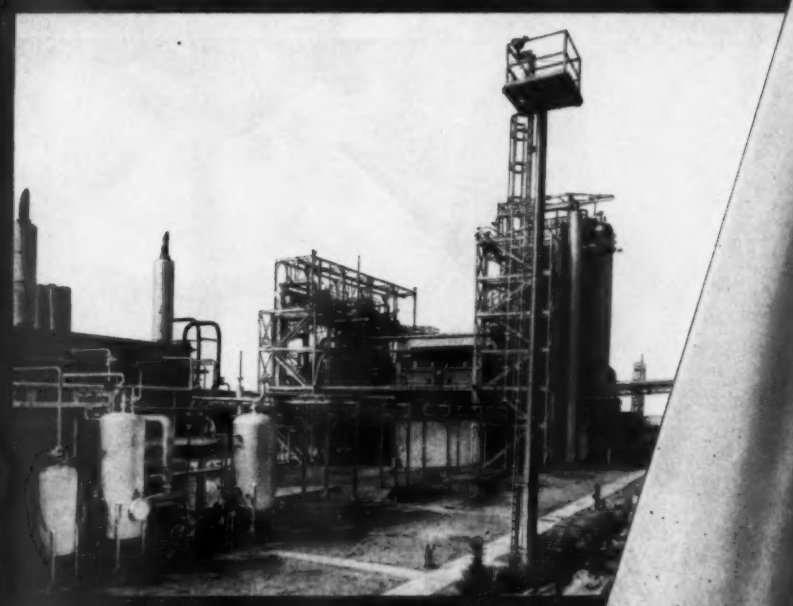

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What General Electric people are saying . . .

J. W. BELANGER

Mr. Belanger is Vice President, Defense Products Group

. . . The significance of the nuclear-powered submarine is that it brings to reality the world's first working atomic power plant—a forerunner of useful atomic power for merchant ships, airplanes, and the generation of electrical power for industry, farms, homes, and many applications for peaceful living.

By the year 2000, nuclear fuels will be the major sources of energy, regardless of whether fossil fuels are seriously depleted.

Fission (splitting atoms with release of energy) and fusion (combining atoms with release of energy) will both be major sources of nuclear power—fission for controlled power sources, and fusion for explosive-type sources.

By the end of the present century, most of the new large utility plants generating electrical energy for homes and industry will operate with atomic (fission) fuel.

The direct generation of electricity from fission is an open question. Who would dare to deny that even it might be commonplace in 50 years?

Solar fuels must also be taken into consideration in any projection that far ahead.

What will this mean to our way of living? Atomic plants will be safe enough to be located within city limits. Residents of Los Angeles and other low-rainfall coastal areas will probably sprinkle their lawns and wash their clothes in fresh water, distilled from ocean water by heat from atomic fuels.

The rapid development of nuclear energy will have advanced the study of many new materials particularly suited for nuclear energy use, but having many other applications. Neutron spectrometry, radioactive logging of borings, widespread use of tracers in industrial processes, employment of radioactive materials in medicine, biology, agriculture and other diagnostic work—these are but a few of the many avenues which may mean little to the average reader at this time, but which on the other hand do mean a great deal to men of science.

Monogram Magazine

D. L. MILLHAM

Mr. Millham is Vice President and General Manager, Lamp Division

. . . There has been a newly awakened realization among electric utilities and electrical equipment suppliers of the broad undeveloped market in the lighting field—particularly home lighting.

Electrical consumption for residential lighting has tripled in the past 10 years but even so only a very small percentage of homes are lighted properly. We found in a recent survey that at the present rate of improvement, it would take residential lighting 100 years to reach the standards already prevailing in many stores and offices.

More and more people are becoming aware of the advantages of good lighting for schools, offices, streets, industry, autos and even airplanes. They enthusiastically appreciate its contributions to beauty, to comfort and safety, and to eye protection of the whole family.

It is up to us to continue to explore new frontiers of lighting knowledge, and to manufacture better products which translate this knowledge into better living for more people.

at Nela Park, Cleveland

General Electric has recently published a booklet entitled WHY STUDY MATH. Written for high school students, it points out the value of mathematics in everyday life, and the necessity of mathematical training for anyone interested in a career in the expanding fields of science and engineering. If you would like a copy, or would like us to send a copy to someone for you, write General Electric Co., Room 2-111, Schenectady, N. Y.

W. R. G. BAKER

Dr. Baker is Vice President and General Manager, Electronics Division

If I were to have anything to say about programming of an educational television station, I would insist that fully half the effort be expended in finding ways and means of inspiring not only the youths but also the adults to extend, continue or renew their education. Don't misunderstand me. I'm not saying that education itself cannot be inspirational. One of the benefits of educational television is that it enables the outstanding educator, or teacher or instructor to inspire thousands and not just a score, or a few hundred at most.

Many obstacles remain in the path of educational television before it will be proven successful. Besides indifference and active opposition, there will be considerable disagreement as to what should be presented to the public and how it should be presented. But these problems are not insurmountable.

I believe that educational television will succeed in the United States because there is unceasing pressure for greater educational opportunities. There is an awareness and a recognition by almost all persons that through education the ills of mind and spirit, yes, and even of ideologies, can be cured or prevented. So much has been accomplished in a few short years. The strides we have made in science and medicine have been giant strides, but we hear no one echoing the sentiments of the man who decades ago urged that the patent office be abolished, because all possible inventions had been made. We have today an even greater awareness of how much we still have to learn and how great the benefits will be to all people.

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Welles Bosworth's name (December Contents page), in honor of the noted architect who designed the Institute's educational buildings when M.I.T. moved to Cambridge, is carved on Building 10.

Raymond E. Hanson

How Well Do You Know Boston?

This Sixteenth Century antique has been seen by thousands of Bostonians on afternoon strolls. Do you know what it is and where it is located? If not, see Contents page for February.

THE TECHNOLOGY REVIEW

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Vol. 56, No. 3

SIXTEENTH CENTURY SPANISH CUENCA TILE • *From Collection of E. Stanley Wires* ..... THE COVER
Crowns, heads, and claws are brown, with rest of double eagle in black, on tinted white background. Tile is 6¾ inches wide, 6⅝ inches high, and varies in thickness from a half to three quarters of an inch.

SUSPENDED LIGHTING UNIT • *Photograph by M.I.T. Photographic Service* ..... FRONTISPIECE 138

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..... BY LEONARD CARMICHAEL 141
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YELLOW FEVER'S ROLE IN HISTORY ..... BY JAMES A. TOBEY 145
Except for the scourge of yellow fever, the Mississippi River might have become the western boundary of the United States.

DECORATIVE TILES, PART I ..... BY E. STANLEY WIRES 147
Progress in man's technology, art, and culture may be traced through 6,000 years of history by means of decorative tiles

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M.I.T. Photo

Let There Be Light!

What is believed to be the largest suspended electrical lighting unit ever installed is now serving the Engineering Library at the Institute. It hangs 51 feet below the skylight of M.I.T.'s great dome in the room which served as the Central Library until completion of the Charles Hayden Memorial Library Building. The dome now houses the Institute's collection of engineering subjects.

The new lighting unit consists essentially of a great dish of corrugated translucent plastic 48 feet in diameter, above which are mounted 236 fluorescent lamps, using about 14 kilowatts of power. The unit, which weighs 16 tons in all, hangs from a framework of steel attached at 12 points to the structural concrete of the dome. In addition to lamps and diffuser, the fixture includes 28 light metal hollow acoustical baffles, each 16 feet long. It is suspended 14 feet above the library floor.

While delivering vastly better illumination to the reading tables in the Engineering Library, the new fixture uses less power than was required for the glass chandelier and floodlights previously used. The lighting unit was designed by Professors Lawrence B. Anderson, '30, and Herbert L. Beckwith, '26, of the M.I.T. Department of Architecture, in co-operation with the F. W. Wakefield Brass Company of Vermilion, Ohio.

THE
TECHNOLOGY
REVIEW

Vol. 56, No. 3

January, 1954

The Trend of Affairs

Sinister

THE human being frequently finds it expedient to conform to the average. Thus the advantage of being average in size was told in the November, 1952, issue of The Review.* Another human attribute where conformance with the majority is a decided advantage is that of handedness. Most people are right-handed, and the world is designed for them. Children who exhibit left-handed tendencies encounter contrary pressure from parents and teachers who, besides the common human impulse to hammer youth into the mold of uniformity, know in their adult wisdom that left-handedness may be some degree of handicap when maturity is reached.

Left-handedness may or may not be an occupational handicap, depending upon the job. Most desk work can be done equally well with either hand. The left-handed policeman needs merely to provide himself with a left-handed revolver holster, readily available. Hammers, screw drivers, wrenches – many of the tools of the mechanical trades – can be used with equal facility with either hand; hence sending someone for a "left-handed monkey wrench" is an outworn joke. But left-handedness is no joke to a tailor, for left-handed shears are hard to find and expensive.

Prime example of a profession where left-handedness is a substantial handicap is that of the dentist. In order to grasp the flexible shaft drill with his left hand, a dentist must stand beside the patient's left hand; in other words, on the opposite side of the dental chair from the usual position. Therefore, in the southpaw dentist's office, all of that bristling array of plumbing and apparatus that surrounds the chair must be reversed from its usual location. Part of this reversal requires special castings and other special parts. Although the left-handed dentist can obtain such equipment from dental supply houses, he pays a premium for it. Also he has difficulty getting his training, because practically all of the equipment in dental schools and dental clinics is right-handed. Incidentally the Armed Services find left-handed dentists a problem, as Army or Navy dentists must use equipment in existing installations, and this is all right-handed.

The Armed Services have now shed new light upon left-handedness, from questionnaires filled out by Selective Service registrants that asked "Are you right-handed or left-handed?" The registrant's reply on the questionnaire was accepted, with no objective test of handedness being given.

An analysis of about 12,000 of these Selective Service questionnaires has recently been published. Of the registrants, 8.6 per cent stated that they were left-handed. Although this percentage cannot be projected to the total population, because these registrants are all young adult males, it leaves no doubt that left-handedness is definitely a minority attribute. Nevertheless this proportion, although a minority, is far from insignificant.

An intriguing finding of the analysis of Selective Service questionnaires came from a comparison of the incidence of left-handedness in men accepted for military service, as against those disqualified. Of the accepted men 7.9 per cent said they were left-handed; of those disqualified, 10.1 per cent. This difference was demonstrated to be statistically significant. Since left-handedness itself is not grounds for disqualification, the question is raised – but in no way answered – as to why this difference existed.

Manifestly left-handedness is common enough to merit careful attention by teachers and vocational counselors. Additional studies of this attribute, done with objectivity and statistical exactitude like the Selective Service study cited, are needed to foster the occupational welfare, perhaps even the general social orientation, of the world's southpaws.

* Frederic W. Nordsiek, "No Virtue Goes with Size," The Technology Review, 55:27.

Vertical Integration

FOR many years the question of divorcing the marketing of petroleum products from the business of producing, refining, and transporting these products has been debated. Oil marketing divorcement bills were introduced in Congress in 1937, 1938, 1939, and 1949. In 1940, the Antitrust Division of the Department of Justice filed the so-called Mother Hubbard Suit against 22 integrated companies, 345 affiliates, and the American Petroleum Institute which, in general terms, laid the groundwork for divorcement. The case was not tried because of the war, and after World War II the Antitrust Division decided to abandon the Mother Hubbard Suit and substitute in its place regional suits containing more specific charges against fewer companies.

Accordingly, in May, 1950, the Antitrust Division commenced a suit against seven integrated oil companies on the West Coast, charging them with conspiracy to restrain competition and to monopolize the production, refining, transportation, and marketing of crude oil and refined petroleum products in the Pacific Coast area. One of the requests, made in this action, calls for the divorcement of marketing from the other branches of the industry. The future course of antitrust policy with respect to marketing divorcement will depend largely upon the outcome of this suit.

As part of a program of providing basic research on business problems which businessmen themselves are not in a position to undertake, a study has been undertaken of vertical integration in the oil industry. The primary question for which an answer has been sought is: Will oil marketing divorcement be economically sound from the point of view of (1) the jobber, (2) the integrated oil company, (3) the public? The study is directed by James S. Cross, Assistant Professor of Marketing, with the assistance of Robert F. King, '52, technical assistant, and is financed through the Sloan Research Fund of the Institute's School of Industrial Management.

The integrated oil company cannot recover profits in other segments of its business which, by design or otherwise, are lost in marketing, except by driving jobbers out of business and recovering these profits at a later date through monopoly prices. There is no evidence that integrated oil companies have undertaken a planned program of eliminating jobbers from the field of petroleum distribution.

It is true that the existence of the integrated structure brings about a drive for volume which may be over and above that which the prudent businessman would seek if he were engaged in marketing alone. When the integrated company is operating at a fraction of capacity or has excess products on hand because of seasonal overproduction, there is an incentive to expand sales by increasing selling costs or reducing price, thereby lowering unit costs by spreading overhead. Expanding sales in this manner is profitable until marginal costs equal marginal revenue.

Because of certain advantages of integration in the petroleum industry, the cost to the public of abandoning integrated channels of distribution would probably be substantial. In particular, the advantages of continuous flow of petroleum products, the stabilizing influence of integration, the greater possibilities for over-all planning and control, the elimination of duplicated effort, and the drive, peculiar to integration, toward cost-saving methods are important sources of efficiency in petroleum distribution.

Thermal Conductivity

WITH the steadily increasing need to operate heat engines and other technological devices at higher and higher temperatures, a number of important design and construction problems have arisen. When temperatures become sufficiently high, metals can no longer be used, and are replaced by ceramics. The need for stable refractory materials of construction for nuclear piles, gas turbines, turbo-jet engines, rockets, and other mechanisms operating at high temperatures emphasizes the need for accurate knowledge of the thermal conductivities of the pure oxide refractories.

An extensive search of the literature reveals that very little data have been published on the thermal conductivity of pure refractory oxides. Moreover, wide divergence of absolute values exists in the published data. Much more accurate data are required for design purposes than has heretofore been available. Accordingly, a new absolute method for determining the thermal conductivity of refractory materials under steady state conditions has been devised at the Institute's Ceramics Laboratory. The project has been sponsored by the Atomic Energy Commission, and research has been conducted by Milton Adams, graduate student in the Department of Metallurgy.

In this investigation, a hollow prolate, spheroidal, ceramic specimen was heated internally by electrical resistance, and the temperatures at two points along the minor axis within the sample were measured by thermocouples. The thermal conductivity may then be expressed in terms of units of heat generated per unit of time, over unit area, for a temperature gradient of one degree per unit of length of heat flow. To insure unidirectional heat flow for proper measurements, the heater core must be so constructed as to generate heat uniformly along the axis of rotation of the sample, and the specimen must be designed and shaped so that its inner and outer surfaces are confocal with the surface of the core. A platinum-wound core was used as a heating element and insulating firebrick was employed as an insulating cover for the specimen. Measurements are believed to be accurate to within 5 per cent of absolute value.

The variation of thermal conductivity with temperature was found for alumina, beryllia, magnesia, thoria, zirconia, and insulating firebrick Babcock and Wilcox K-28. Alumina thermal conductivity decreases from 0.0225 at 500 degrees C. to 0.0125 at 1300 degrees C.; beryllia decreases from 0.17 at 400 degrees C. to 0.040 at 1200 degrees C.; magnesia decreases from 0.040 at 400 degrees C. to 0.014 at 1300 degrees C.; thoria decreases from 0.014 at 300 degrees C. to 0.005 at 1300 degrees C.; zirconia is practically linear from 0.004 at 100 degrees C. to 0.005 at 1300 degrees C.; and insulating firebrick Babcock and Wilcox K-28 increases from 0.00063 at 300 degrees C. to 0.001 at 750 degrees C.

Psychology, the Machine, and Society

To Attain a Better State, We Must Spend More Energy and Thought Than in the Past on Improving the Quality of Instruction We Offer Young Persons

By LEONARD CARMICHAEL

LAST spring in the sky over Korea when a pilot in one of our fast jet airplanes sighted an enemy jet approaching, he had to respond quickly, if at all. The human eye-nerve-muscle system requires at least one-fifth of a second to operate after such stimulation. If a directional movement trend in another airplane is to be estimated, a much longer time is needed. During the period required for effective human response, two jets move hundreds of feet from where they were when the stimulation was initiated. In 1909 at the first Gordon-Bennett air race the winning airplane averaged just over 47 miles per hour. Today airplane speeds of more than 15 times this rate are not uncommon, whereas the average speed of the operation of the human sense organs, brain, and muscles has not changed in these years. Indeed, it is very doubtful whether the best human reaction time of an ace pilot of the Korean war was different from that of a leading archer of the New Stone Age, when the bow and arrow had just been developed by the neolithic counterpart of our Atomic Energy Commission of the Twentieth Century.

There is, thus, a hard reality behind some of the present-day lurid science fiction: Men have now made machines that are challenging the inborn anatomical and mental limitations of their masters. Furthermore, in the past few years increase in speed of travel, ease of world communication, potential military destructiveness, and the eradication and control of disease have violently upset the slowly evolved balance of the ages between the individual and his material and social world. These facts emphasize the need for a scientific consideration of man's fixed and sometimes inborn physiological and psychological capacities, in relation to novel and ingenious machines, to newly released energy sources, and especially to political and economic systems that are now so rapidly transforming the world.

Man has studied and speculated about his nature for many centuries. Probably ever since he first saw his reflection in a prehistoric pool he has wondered about himself. Throughout the ages, theologians, lawyers, physicians, philosophers, poets, mythmakers, and more recently anthropologists, psychiatrists, geneticists, physiologists, sociologists, and many other specialists, as well as psychologists, have pondered aspects of the great question: "What is man?" None has yet produced the final answer. Not even the most ardent present-day advocates of the usefulness of psychology would dream of maintaining that this one area of study alone can ever give a full reply to this obdurate riddle of the Sphinx. Nevertheless, modern experimental psychology has developed some useful techniques and is still obtaining factual, fundamental information about human nature. The present-day relationship between human beings and machines and society is being made more understandable by this science in more than a few respects. When the student of mental reactions is asked, "What are the capacities of human individuals?" his answer today is far from complete, but it is possible to approach an answer in modest, factual terms.

The wise psychologist does not attempt to predict the nature of the end products of human artistic creation, or try to determine the boundaries of man's highest intellectual potentialities or spiritual and aesthetic insights. Rather, psychologists try to describe, wherever possible in quantitative terms, basic mental processes, which are often shown to be related to the anatomical and physiological living machinery of a unique primate called Homo sapiens.

Many questions similar to the following can be asked and to a limited degree answered by scientific psychology: What is the average difference between man's fastest reaction to a sound and to a light? How fast and how accurately can different human individuals learn specific items of information, such as series of numbers? How rapidly does forgetting of specific new associations take place? How do individuals vary in the composite of abilities, sometimes called intelligence? What are the typical changes in the expression of emotion as an individual grows from babyhood to adult life? What is the effect of sleep deprivation on skilled motor performance? How is language related to thought?

The extent of new knowledge in this field is illustrated by a *Handbook of Human Engineering Data*[1] recently published by Tufts College psychologists under contract with the Navy. This book, which has the external dimensions of the New York City telephone directory, is a compilation of the present state of useful psychological facts about the measurable traits and abilities of human beings. Its pages give hundreds of tables and graphs representing the results of experimental study of specific aspects of mental capacity. Many of the tables show averages and also give extremes of variation. In such studies of human mental characteristics, individual differences are rec-

[1] *Handbook of Human Engineering Data for Design Engineers* (Medford: Tufts College, 1949).

Russell Adams

Men have now made machines that are challenging the inborn anatomical and mental limitations of their masters.

ognized as important. There is no better established fact about men, women, and children than that variation is the most invariable law of nature. The amazing range of human capacity in any population is one of the first facts to be recognized by one who is concerned with making better machines for human operators or even with speculation about social, political, or economic theory or reform.

In general, therefore, the information made available as a result of experimental psychology is fundamental in concrete thinking concerning the present-day changing relationships between man and his world. The engineer who builds a new Diesel locomotive is limited by the properties of the materials he uses. The weight, tensile strength, heat resistance, elasticity, and other characteristics of the metals he employs do not predetermine the shape into which the material is to be fabricated. On the other hand, parts of such engines cannot be made of metals that have other than very specific characteristics. The same relationship holds for one who would consider how modern machines and present-day society are related to the inborn traits of every human being. "Which of you by taking thought can add one cubit unto his stature?"[2] also applies to other characteristics besides height. The jet pilot, already referred to, cannot by thought, education, or wishing speed up beyond a certain fixed point the time his nerves must take in responding to external stimuli. Anyone concerned with the construction of new airplanes or with training pilots to fly such airplanes in formations, or with developing a better political or economic system, must not forget that physiologically and psychologically men have a large number of inborn capacities and many specific limitations.

As a first conclusion of this paper, therefore, may it be suggested that a modern and effective understanding of men will certainly involve a number of levels of study? Among the types of information that will be required in considering man's complex relationships to his total environment will be as accurate as possible a knowledge of the basic make-up of human beings.

This point of view was well expressed by Arthur D. Little,'85, in whose honor this lecture is named. He wrote: "Since most of the troubles that beset mankind have their origin in human nature, it would seem worth the while of those who make laws to study and apply the findings of the biologists and psychologists as to what human nature really is and what are the springs of its motivation." Though this was written 25 years ago, it is even more clearly true today than it was then.

Much more research in basic scientific psychology is therefore an urgent need of our age. "If only," says Professor Ivor A. Richards (Harvard University), "something could be done in psychology remotely comparable to what has been achieved in physics, practical consequences might be expected even more remarkable than any that the engineer can contrive. The first positive steps in the science of the mind have been slow in coming, but they are beginning to change man's whole outlook." Our educational system, too, may well be planned so that proper and adequate training in psychology may be given and so that enough able young men and women in each generation are allowed an opportunity to become experts in this field. Experimental psychology and human engineering have contributions to make to machine design and what is more important even to social understanding.

Let us now look at the second noun of our title — the machine. Many of the pleasant and interesting, as well as many of the alarming, characteristics of our age are a direct result of machines and of other new processes and procedures following upon man's growing understanding of pure and applied science. The past 15 decades have seen more developments which are based on quantitative and exact methods of studying nature than all preceding ages of history. During this period, in such societies as ours, science has made possible the release of man from drudgery in a way that was previously unthinkable. New sources of energy, and now atomic power itself, have been substituted for the old inefficient and painful work of human or animal muscles. Some great periods of the past were based upon the forced labor of mute human slaves. Today machines, our new and willing servants, relieve us from much of the relentless work that was accepted as inevitable by the unbroken line of our toiling ancestors.

Novel electronic systems are today being developed, for example, here at M.I.T., which will further lift the

[2]Matthew 6:27

curse of drudgery not only from man's biceps and triceps but even from his mind. If human beings by their social blundering do not bring on war or political chaos and thus capriciously spoil this process, we may logically hope that the technology of the present and future will be even more humanly valuable than it has been in the past. It must be remembered also that advances in medical and public health fields in the last generation have been without precedent. The average length of life has been increased and human beings have been relieved in an almost unbelievable way from much of their physical suffering, which, like muscular toil, had always before been accepted as the inevitable lot of all sons and daughters of Adam.

The support of research in pure and applied physical and biological science is thus eminently worth while. If society is to operate efficiently, the best modern psychological and personnel procedures must be used to discover in each generation those individuals who are best qualified to be educated so that they may in their turn carry on effective research and development in these fields. Such able individuals should also be encouraged to undergo the self-discipline and the training in mathematics and other basic fields of study required of those who are to do real research in science. This kind of preparation is absolutely essential to those who would wisely direct and maintain as well as develop the machines, processes, and services on which the modern world depends. Nature does not provide enough children in each generation who have oustanding mathematical and other academic aptitudes, as well as the personality characteristics necessary to become true modern scientists, to allow any to be wasted. It has been suggested that creative research of the highest order in the quantitative physical sciences can be expected only from selected individuals in the upper 2 per cent of the population in measured intellectual ability. Such rare and valuable talent bearers should be nurtured and helped to use their inborn capacities for the welfare of our scientifically based age. The world cannot afford to squander its scientific man power! It is particularly wasteful of human resources when individuals, recognized as singularly talented and perhaps well trained in certain scientific or technical specialties, are allowed or required either in military or civilian life to perform tasks that others can do as well or even better.

Dr. Little, again, saw with peculiar clarity the need of fostering able scientists. Men of science constituted for him a separate Fifth Estate in society. He said in a memorable paragraph: "This Fifth Estate is composed of those having the simplicity to wonder, the ability to question, the power to generalize, the capacity to apply. It is, in short, the company of thinkers, workers, expounders, and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge called science."

As a second conclusion of this paper, then, it may be suggested that society should give full attention to the discovery of human talent and to the effective education of promising leaders in pure and applied science and, it may be added, in other worth-while scholarly fields. That all men are not born equally able to use mathematics is but one of many facts that must be accepted by those who are to plan wisely and well for the education of our youth for effective service to society.

From time to time we hear the monstrous notion proposed that a moratorium on scientific research should be established. Those who make such suggestions mistakenly blame science for our present social ills. Can anyone, however, with clear eyes doubt that the world now needs more, not less, science, and a wider, not more restricted, recognition of its implications and importance?

Men still ask themselves over and over again: Why have human beings who have made such good machines and such progress in understanding the cause and cure of many human illnesses, failed in creating a just and stable national and world social order? The author of this paper knows that he cannot answer this great question, but he still believes that it is worthy of the best thought of all of us. In the first place, the fact that the world has not yet developed a thoroughly workable political and economic organization cannot be blamed upon the failure of many men to consider the matter. For centuries philosophers, statesmen, political scientists, aspiring dictators, and even glittering soldiers of fortune, like Napoleon, have thought and talked about the need for social and political change and improvement on a world-wide scale. Sometimes it almost seems that society has suffered not so much because it has failed to consider its own improvement but rather because it has been tampered with by too many would-be reformers. Many of these advocates of social change have not understood, or wanted to understand, what we have called in this paper the basic nature of human beings.

The kind of thinking that has been so triumphantly successful in developing purely mechancial systems has not always worked when applied hastily to man's relationship to man. Edmund Burke, who was certainly one of the outstanding political scientists and philosophers of the Eighteenth Century, emphasized this fact. He spoke of ignorant men who were not fools enough to meddle with their own clocks but who still felt free to advocate the taking apart of society,

Bell Telephone Laboratories

Novel electronic systems are today being developed which will further lift the curse of drudgery for man.

and the disrupting of its immemorial springs, balance, counteractions, and co-operating powers.

For years sociologists have said that in some respects society is like an organism. This analogy may be carried too far, but it does seem to be true that in old and well-established communities there is an almost organic unity in the structural pattern of social living. Successful, modern physicians do not try to create new organisms in the place of the patients they are called upon to treat. Medicine rather has learned to alter the processes that interfere with health and to recognize that a real cure is usually the result of restorative processes inherent in the body. These processes may be thought of as part of the body itself and have been produced by millions of years of organic evolution. This approach of the modern medical scientist may have a lesson for the social and economic reformer. Today, however, looking back at the social changes that have been advocated in the relatively few years since the French Revolution, one can hardly escape the conclusion that would-be social doctors have all too often tried to put together a new society and not to cure the old one. They seem not to have realized that some aspects of man's social organization, like the human species itself, have grown by the slow evolution of possibly a million years of man's living with man on this planet. Some inborn and essentially unchanging physiological and psychological characteristics of the human organism make certain social patterns more effective than others.

Social advances in recorded history there certainly have been. Democracy as we know it at its best is an example of such progress in man's estate. The abolition, in many parts of the world, of human slavery is another sure advance. It is distressing to realize, however, as we think of both democracy and the abolition of slavery, that we are living in an age in which new patterns of dictatorship and of human servitude are again being fostered by some of those who talk most loudly about creating society on a new mechanical plan.

In view of our present world conditions it is surprising to remember that many of our academic parents and grandparents convinced themselves that all, or almost all, social change of any sort was real social progress. Many of them had the simple faith that various types of social disruption, which they advocated, would lead to social uplift for the benefit of mankind everywhere. Some Victorian intellectual leaders adopted uncritically what now seems to have been a deceptively attractive general idea. They looked at the most external aspects of Darwinian biological evolutionary theory and then suggested that the same factors which were assumed to have operated during millions of years in the development of species of plants and animals could be counted on in a few decades of human planning, or telic social evolution, to establish a wholly new society. These reformers never dreamed of the difficulties of our age that followed the social upheaval they did so much to promote. In Nineteenth Century England many academic reformers cheered in a polite way as the age-old influence of the Established Church and of religion in general was being undermined. They saw only good in the passing of the remnants of the ancient stratification of society. They closed their eyes to the fact that many of those who were born to so-called special privilege traditionally recognized that they had inherited, along with the rights and status of their class, certain inescapable social obligations. The reformers who rejoiced most at the passing of the established order did not have clear enough eyes to foresee that the theory of social change they advocated would later be stretched to form a basis for a police state and the denial of the enjoyment of human personal liberties.

As Russell Kirk has recently sagaciously and persuasively pointed out, from the time of the French Revolution on, there have been those who have seen the dangers inherent in unbridled social change. John Adams, our second President, was such a philosopher. So was the often misunderstood English statesman Disraeli, and in a very different way, Matthew Arnold. There have been many others. In more recent times George Santayana, Irving Babbitt, Paul Elmer More, T. S. Eliot, and Peter Viereck have made clear some of the errors in much of the thinking of the socialists, collectivists, and disrupters generally.

Jeremy Bentham, John Stuart Mill, and other utilitarians and Fabian socialists were great hands at suggesting how Humpty-Dumpty-like human society could be broken apart. It now seems that they, like all the king's horses and all the king's men, were not equally good at suggesting means by which the organic structure of our slowly evolved society could again be regenerated after it had been shattered. Not a few modern thinkers agree, and with some reason, that our civilized world owes many of its worst disorders to the verbal blandishments of the romantic writings of Rousseau. Certainly no philosopher ever espoused a much more unrealistic psychology of human nature than did this brilliant vagabond and revolutionary thinker. After the fall of the old regime in France a whole succession of dreamers, utopians, and sentimental socialists in various countries, often explicitly influenced by Rousseau, advocated turning many of the established laws and principles of society upside down. The idea that a freely competitive economy is a high expression of man's inborn nature seems currently to be gaining ground as the practical impossibilities of the so-called classless society of socialism or communism are disclosed. That the legal sanctity of private property is a prime guarantee of our human freedoms is probably better recognized today than at any other time in the past century.

Even the late Maynard Keynes, not always the most conservative of economists, recognized the point of view here being considered. Dr. Kirk, in his recent admirable book, *The Conservative Mind*,[3] quotes Keynes as saying: "Benthamism I do now regard as the worm which has been gnawing at the insides of modern civilization and is responsible for its present moral decay. We used to regard the Christians as the enemy, because they appeared as the representatives of tradition, convention, and hocus-pocus. In truth it was the Benthamite calculus, based on over-valuation

(*Continued on page 160*)

[3]Russell Kirk, *The Conservative Mind* (Chicago: H. Regnery Company, 1953).

Yellow Fever's Role in History

Epidemics — and Their Conquest — Have Repeatedly Unrolled New Maps and Changed the Course of History

By JAMES A. TOBEY

THROUGHOUT the ages the fortunes of men and the destinies of nations often have been dominated by disease. Epidemics of the past frequently devastated great armies and controlled the results of decisive military campaigns. Disastrous outbreaks of cholera, plague, smallpox, typhus, and other maladies have interfered with exploration and colonization, interrupted trade and commerce, destroyed cultures and social orders. Endemic diseases, such as malaria and yellow fever, have been responsible for the disappearance of glowing civilizations, notably those of the Mayans and the ancient Greeks. By the sudden and dramatic striking down of kings, statesmen, generals, and other leaders, disease repeatedly has changed the course of history.

Pestilence has played an interesting part in the history of our own country – a role which is now more or less forgotten and is generally overlooked by the professional historians. If, for example, it had not been for the presence of the dreaded yellow fever in the Americas a century and a half ago, the western boundary of the United States today might be the Mississippi River.

The story really begins in 1682 when a gallant gentleman of France, René Robert Cavelier, Sieur de La Salle, crossed the wilderness from Fort Frontenac in Canada to the vicinity of Lake Peoria in what is now Illinois, and sailed some 2,000 miles down an unknown river. At the mouth of this mighty stream, called by the Algonquin Indians "Missi Sipi" or Great River, La Salle took possession of all the territory drained by the river and its tributaries in the name of his sovereign, Louis XIV. In his honor, this vaguely bounded territory was named Louisiana.

After building a number of forts, La Salle returned to France, where he found favor at the court, despite the usual intrigues by his enemies. Holding the appointment as governor of Louisiana, he set sail in 1684 in four ships with 400 men to garrison the new province. En route the naval commander, one Beaujeu, refused to take any orders from La Salle and by his ineptitude managed to lose the main supply ship to hostile men-of-war of Spain. Eventually, however, they reached the West Indies, but here La Salle and most of his force promptly came down with the fever which was indigenous in this region. Undoubtedly it was the fearful vomito negro, which we now know as yellow fever.

La Salle's illness was of such long duration, and so many of his men succumbed to it – more than 200 – that the expedition was almost completely disorganized. Finally, with only 180 men La Salle went on, but sailed too far westward, missing the mouth of the Father of Waters and landing on the shores of what is now Texas. Here disaster followed disaster: two of his ships were wrecked and one returned to France, while disease and privation reduced the force to only 45 persons. In desperation La Salle attempted to reach Canada overland, but failed. In a second try, in 1687, his men mutinied and assassinated their valiant leader. A paltry few made the hazardous journey to Fort Frontenac: most were murdered by the Indians. Thus ends the first chapter.

France sent out others, Ryswick, Iberville, Crozat, Bienville, to establish colonies in Louisiana – colonies which flourished more or less despite the unfavorable climate and the constant presence of disease. In 1762 by a secret treaty the whole territory was transferred to Spain, but the new owners did not assume full possession until 1769 when a general with the good old Spanish name of Alejandro O'Reilly came to New Orleans, which had been founded in 1718 by the Sieur de Bienville. In 1763 another treaty had ceded all the area east of the Mississippi to Great Britain, and this came to the United States in 1783 after the ending of the successful American Revolutionary War. Not until 1794 was Spain persuaded to recognize the Mississippi as the new nation's western boundary and to grant the right of free navigation along its waters.

Then in 1800 Louisiana suddenly reverted to France, ruled by General Bonaparte as First Consul. At the same time Spain turned over to France the eastern part of the island of Santo Domingo, which had been held by the Spaniards since its discovery by Columbus in 1492, although the western part of the island, known as Haiti, had been a French possession since 1697. When this treaty took effect, the master of the entire country was the full-blooded descendant of an African king, Toussaint L'Ouverture, who had raised, disciplined, and trained an army of Negroes, renounced France's authority, and audaciously called himself the "Buonaparte of St. Domingo."

In 1801 Bonaparte decided to send a large military expedition to Haiti to regain control of the country, to put that other upstart Toussaint in his place, and to provide a garrison for future duty in his domain of Louisiana. Now begins the second chapter of the story; the narrative of conquest by, rather than of, a disease.

The great expedition consisted of 26 ships of the line under an admiral, Villaret de Joyeuse. This convoy, reluctantly permitted to sail by the British, car-

ried 20,000 seasoned troops commanded by General Charles Victor Emmanuel Leclerc, who happened to be the husband of Bonaparte's sister, Marie Pauline. For some strange reason, the First Consul insisted that Pauline accompany her husband on this ill-fated expedition, from which she returned a widow.

General Leclerc, an able veteran of the Army of the Rhine, met with no serious military difficulties. Toussaint promptly fled to the hills with his followers, and the French were masters of the situation within 90 days. Toussaint knew, however, that he had an insidious ally which would come to his aid with the approach of the hot weather.

That hidden enemy of the French was the yellow death. It struck suddenly, and within a few weeks had swept through the invading forces with terrible violence. In the short span of two months more than 15,000 French soldiers had perished from yellow fever. Among the victims were 20 generals, including the commander himself. In vain did the First Consul double the size of his army in Haiti, but the relentless pest continued to take its toll. Whole divisions, as one medical historian puts it, "melted like wax in the sun."

Toussaint, biding his time in the hills, was treacherously lured to the capital by the French, was arrested and sent to France, where he died in jail in April of 1803. He was succeeded by the savage Jean Jacques Dessalines who defeated Leclerc's successor, General Richambeau, and his sick and depleted army in November of that same year.

The French troops, it must be remembered, had been intended for duty in Louisiana after the simple task of subjugating Santo Domingo had been accomplished, but unfortunately for France, no healthy troops remained to undertake this mission, particularly important in view of a threatened expedition by the British against New Orleans. Thwarted by yellow fever and faced with failure in his ambitious colonial ventures, the future emperor of France suddenly called in the American minister in Paris, Robert Livingston, and offered to sell to the United States the entire territory of Louisiana. Napoleon Bonaparte blandly made this astonishing offer despite his most solemn pledge to Spain never to alienate the territory. Pledges then, as now, meant little to despots bent on conquering the world.

Mr. Livingston was taken by surprise. Acting on instructions from Secretary of State Madison, he had been angling with Bonaparte's minister, Talleyrand, for a small section of Louisiana, including the city of New Orleans and West Florida. In the new negotiations he was joined by James Monroe, whom President Jefferson had sent to Paris as envoy extraordinary, and together they decided to exceed their instructions, throw caution to the winds, and acquire Louisiana for their country. For this area of more than a million square miles they paid 60,000,000 francs and assumed debts and claims for another 20,000,000. This amounted to $15,000,000 or about $0.04 an acre for one of the world's richest agricultural sections. Out of this territory were carved 13 of our Midwestern states.

Thus, on April 30, 1803, did yellow fever unroll a new map – one which practically doubled the size of the new nation in North America.

During the period when these dramatic events were taking place, yellow fever made frequent visitations to the United States itself. It came usually by ship from the West Indies where this terrible affliction had been endemic for a century or more. Tradition has it, in fact, that Christopher Columbus suffered from yellow fever on his second voyage to America at the end of 1493, but authorities believe that the *modorra* of Columbus at this time was something else and that yellow fever was unknown in the Western Hemisphere until it was imported from Africa by the slaves brought to the West Indies by the Spaniards early in the Sixteenth Century. The disease was not accurately described in the Americas until 1635, and the first recorded epidemic of it began in the Barbados in 1647 and quickly spread throughout the West Indies and into Mexico and the Yucatan.

At any rate, yellow fever came to New York in 1668 and to Boston in 1691. Two years later it was noted in Philadelphia and Charleston, and in subsequent years it went as far north as Portsmouth, N. H., Montreal, and Quebec. Between 1699 and 1893 no less than 148 epidemics of yellow fever were recorded in what is now the United States. The last one of any consequence occurred in New Orleans in 1905, and since that time yellow fever has been banished from our country.

The worst of the early epidemics of yellow fever broke out in Philadelphia in 1793, causing some 4,000 deaths out of a population of about 60,000. It also caused panic in what was then the nation's capital. George Washington was in the city at the time, but remained in the suburbs and escaped the disease. Alexander Hamilton contracted it, but recovered, although a less fortunate victim was the first husband of the future Mrs. James Madison. Dr. Benjamin Rush, the leading physician of the time and a signer of the Declaration of Independence, was stricken but recovered and continued to minister to his patients. Dr. Rush and his colleagues came to the conclusion that the epidemic was due to miasmatic conditions, particularly a lot of spoiled and rotting coffee on one of the docks. In a later outbreak, in 1797, he did, however, make the interesting observation that there seemed to be an unusual prevalence of mosquitoes.

The most severe of all of the epidemics of yellow fever in the United States occurred in 1878, following less extensive outbreaks in 1873 and 1876. The entire Mississippi Valley and all of the Atlantic Coast states were affected, but the brunt was borne by the cities of New Orleans, Vicksburg, and Memphis. It is estimated that fully 100,000 persons were afflicted, and that there were 20,000 deaths. The situation was so serious that President Hayes sent a message to Congress about it, and Congress created a National Board of Health to cope with the emergency. By 1882, when the excitement had died down, our first and only National Board of Health went into a state of desuetude, although it did not cease to exist, officially, until 1893.

During our war with Spain in 1898 yellow fever played havoc with the susceptible American troops, particularly in Cuba. In this brief war about 5,000 soldiers succumbed to disease – yellow fever, typhoid

(*Continued on page 168*)

Decorative Tiles

THEIR PLACE IN CERAMIC ART—PART I

For More Than 6,000 Years, Decorative Tiles Have Yielded a Clue to Man's Technology and Culture

By E. STANLEY WIRES

Much has been written about pottery and porcelain, but very little has been written about the important part that decorative tilework has played in the development of the ceramic arts. Historically, pottery and tiles have probably been the most important means of tracing the culture of mankind, and ceramic collections are libraries of history.

The proper study of this subject should be through the massed effect of many tiles, but the collector must base much of his research upon the design and color of the individual tile. It is also necessary to visualize a span of at least 6,000 years, and to follow the fast-moving history of those countries bordering the Mediterranean Sea, through northern Africa to Spain, through Central Europe to England, and eventually to America. The westward course of development of decorative tiles is shown in the accompanying map, Fig. 1.

Tiles of Ancient Egypt, Babylonia, Assyria, and Persia

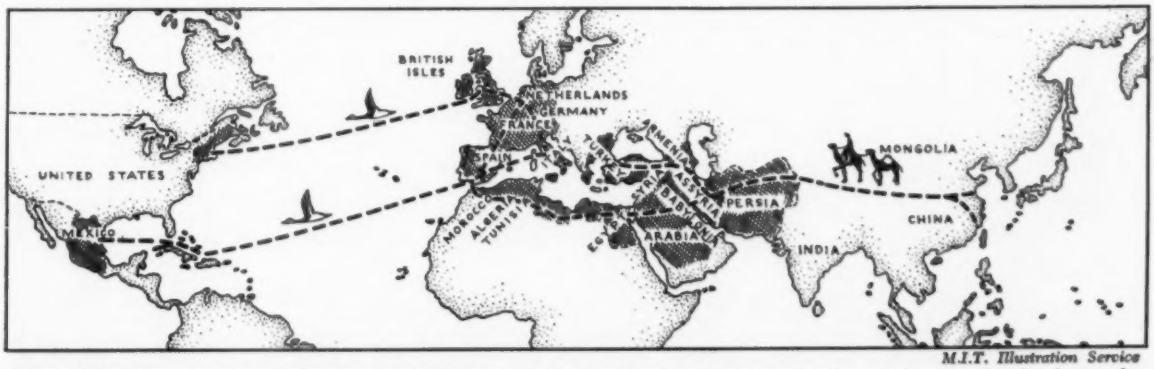
Decorative and glazed tiles, as we know them, originated in Egypt about 4700 B.C., but due to a plentiful supply of building material the ancient Egyptians never developed the architectural use of tiles to any great extent. In the tomb chamber of what may have been the first stone building in the world, the Pyramid of Sakkara, the walls were lined with two-inch by one-inch blue glazed tiles, and the door jambs with painted tiles. On the back of each tile a perforated tenon was provided, through which copper wires were passed to secure the tiles to the wall.

The use of ceramic decoration and enameling in Babylonia and Assyria was derived from Egypt. These countries were part of the Tigris-Euphrates Basin, the whole district being known as Mesopotamia, where the architectural material was largely the humble clay of the river bed. Babylonia dominated the valley until about 1100 B.C. when the Assyrians came into power and ruled the country from their capital at Nineveh. Under the rule of King Nebuchadnezzar, whose reign lasted 43 years, Babylonia again regained its power, to be relinquished in 538 B.C. to Cyrus, King of Persia.

Ceramic decoration in these countries took the form of both glazed and unglazed brick walls, with pictorial designs in low relief, as shown in Figs. 2 and 3. The splendor of design and color – rich blue, red, yellow, and black – is comparable with the later tile-mosaic of the Saracens.

Two of the best examples of this work were in the Palace of Sargon, King of Assyria, at Khorsabad, and upon the walls of the sacred street of Marduk (Shrine of God) leading to the Ishtar Gate of ancient Babylon. In the great Palace of Sargon, which was said to cover 25 acres, the colored murals lined the arches at the entrances of the approach ramps, up which the king's chariots were driven. On the walls bordering the sacred street of the God, Marduk, the enameled decoration was a procession of animals – lions, unicorns, bulls, and curious dragons – all sacred to the cult of Ishtar.

The very important part that Persia took in the development of ancient ceramic art centers around the Achaemenian period 558-333 B.C. In this period, from the time of King Cyrus, Susa was the residence of the Persian kings, but under King Darius I, a great



M.I.T. Illustration Service

Fig. 1. Tilemaking covers a period of at least 6,000 years and follows the development of history of the countries bordering the Mediterranean Sea, through northern Africa to Spain, through Central Europe to England, and eventually to America.

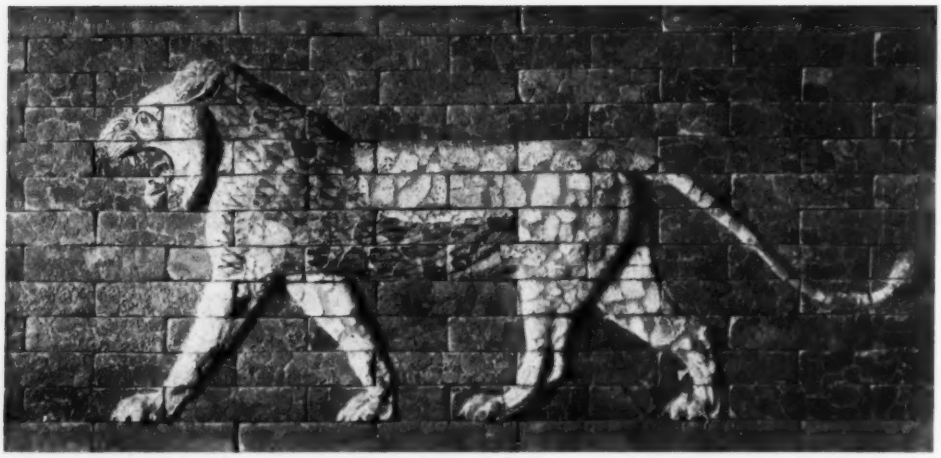
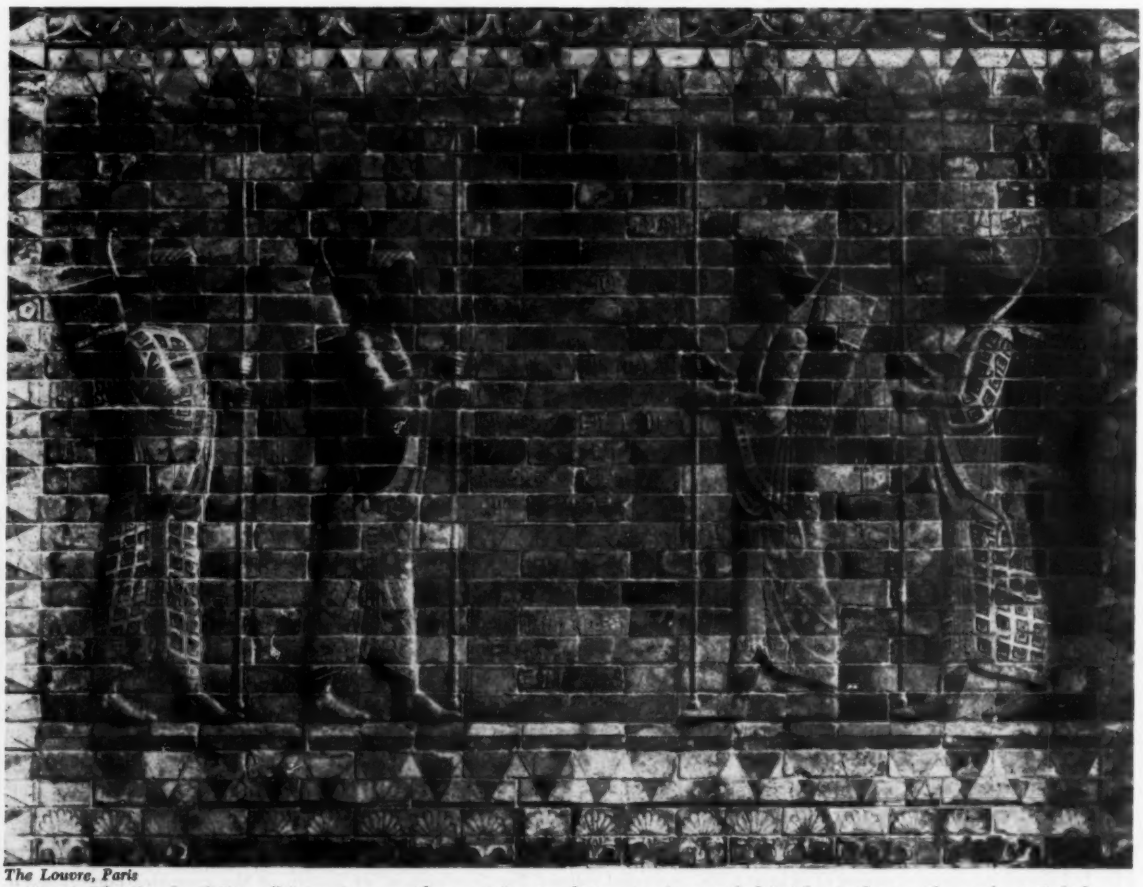


Fig. 2. Among the decorations on the walls bordering the Processional Way in Babylonia, Sixth Century, B.C., appears this glazed lion. Major colors used in tiles of this era were rich blue, red, yellow, and black.

Boston Museum of Fine Arts

palace was constructed and typical examples of enameled brickwork were the "Lion's Frieze" (Fig. 2) and "Archers' Frieze" (Fig. 3). Although both of these examples are similar to the work of Babylon, the detail and color composition of the "Archers' Frieze" — with its brown of the skin, and robes of yellow or white relieved by colored rosettes — has similarity to the later work of Saracenic Persia.

With the fall of the Achaemenian line of Persia, when Alexander the Great crossed the Hellespont and gained control in 335 B.C., the technique died out and neither the Greeks nor the Romans made any extensive use of tiles. It was also true that India's role in the ancient history of ceramics was not important. The Indian people, somewhat like the Chinese, had little intercourse with other people at that time. It was in the later Moslem rule that the decorative tilework of India was brought to a climax through Mogul architecture, the most important example being the Taj Mahal at Agra.



The Louvre, Paris

Fig. 3. The "Archers' Frieze" from Susa, residence of Persian kings, is of enameled brick, similar to tile work of Babylon.

Tiles of Saracenic Persia, Syria, and Turkey

The Moslems, followers of their God (Allah) and the prophet Mohammed (570-632 A.D.) had their rise in Arabia and soon conquered their neighbors. Upon the death of Mohammed, his friend Caliph Abu Bekr became the leader and deliberately started to conquer the world for Allah. Rexford Newcomb's* "Architectural Monographs on Tilework" gives the following partial events outlining Saracenic history:

638 A.D. – Syria and Asia Minor conquered
640 A.D. – Egypt and Mesopotamia taken
643 A.D. – Spread into North Africa
644 A.D. – Persia proper conquered
661–750 A.D. – Omayyad Dynasty, Capital Damascus
711 A.D. – Saracens enter Spain
732 A.D. – Spread into France and defeat by the Christian army of Charles Martel at the Battle of Tours

The Arabs, having the oriental love for display and color and being decorators rather than great architects, quite naturally adopted and developed the ceramic arts of the conquered people. Whether these tilemakers had any knowledge of the work of their Achaemenian forefathers may be questioned, but it is clear that they had years of experience and laid the foundation for a great ceramic revival. The great devastation, such as that afflicted by the Mongols under the leadership of Genghis Khan, did not destroy the potter's art. The lives of the craftsmen were usually spared and often ceramic artisans lived with the strong and prosperous rulers.

Probably Persia played the most important part in the development of decorative tiles, and the finished tilework of this country – of which Fig. 4 is a good example – exhibited a degree of skill and feeling for the material that has rarely been equaled.

For progress during the period from 622 to 1200 A.D., the historians of today can piece together only bits of information obtained from a limited number of excavations. The cities of Rakka, Rhages, and above all, Sāmarrā, have each contributed their share of fragmentary proof.

The earliest tiles were found at Sāmarrā in the Ninth Century. They were large 10½-inch squares surrounded by oblong hexagonal units, painted in red, green, yellow, and golden-brown luster. Between the Twelfth and Fifteenth Centuries, Persian tilework reached its perfection and as a result the mosques, public buildings, and even the houses of such magnificent cities as Rhages, Tabriz, Ispahan, and Veramin were resplendent with brilliantly glazed wall tiles (Fig. 6), lustered in golden brown changing to an iridescent film of green, purple, or ruby red in the changing light. This luster technique, unique with Persia, was to influence later European tilework, especially that of Spain, as a sequel to the Moorish invasion.

As the Moslem religion prohibited the use of animal and human forms in religious design, we find a marvelous use of lustered Koranic inscriptions raised in low relief, with background of stylized foliage, as in Fig. 5.

Another characteristic shape was the eight-pointed star combined in pattern with the cruciform, as shown in Fig. 8. These tiles were produced from inferior white clay, surfaced with a slip (liquid clay), decorated in delicate patterns, with a final overglaze resulting in a rich color effect. The predominating colors were cobalt blue, turquoise, and copper green combined with the iridescent chocolate-brown luster. The decorative motifs covered a wide variety of subjects – the conventional pink, rose, hyacinth, and arabesques, the hare, the deer, and several kinds of birds.

Totally different from the painted tiles is the technique of tile-mosaic, shown in Fig. 7. The separate pieces were cut from large, glazed tiles already fired. They were then fitted to a pattern face downward, covered with reinforcing canes over which the mortar was poured. When dry, the panel was placed in its proper position on the wall. Famous examples of this tile-mosaic work are the Blue Mosque at Tabriz, completed in 1465 A.D. and the Tomb of Tamerlane at Samarkand.

To overcome the labor of cutting the pieces, a method made necessary to prevent colored glazes from running together, the Persians developed a dry

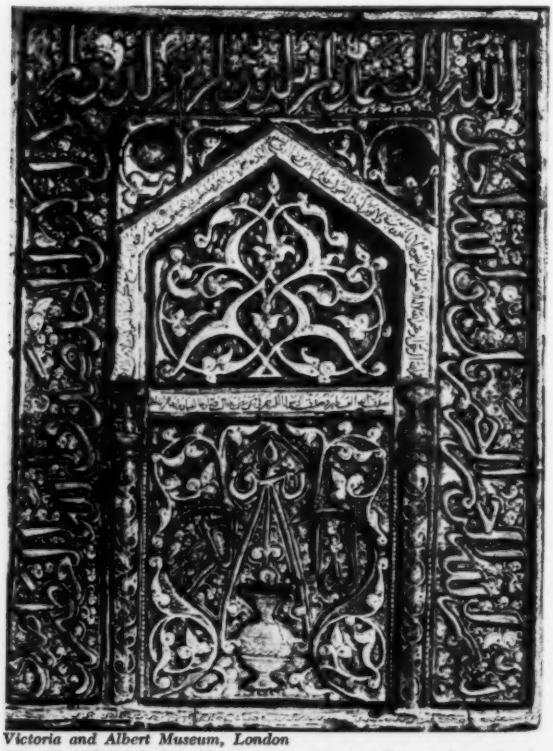
Victoria and Albert Museum, London

Fig. 4. Persian wall tile of the Seventh Century exhibits an unusual degree of skill in decorative tiles.

* New York: Associated Tile Manufacturers, 1924.

Victoria and Albert Museum, London

Fig. 5. As demonstrated by this lustered tile of the Thirteenth Century, inscriptions raised in low relief and with background of stylized foliage were common in Koranic tile. This form of art evolved from the prohibition, by the Moslem religion, of animal and human forms in religious design.

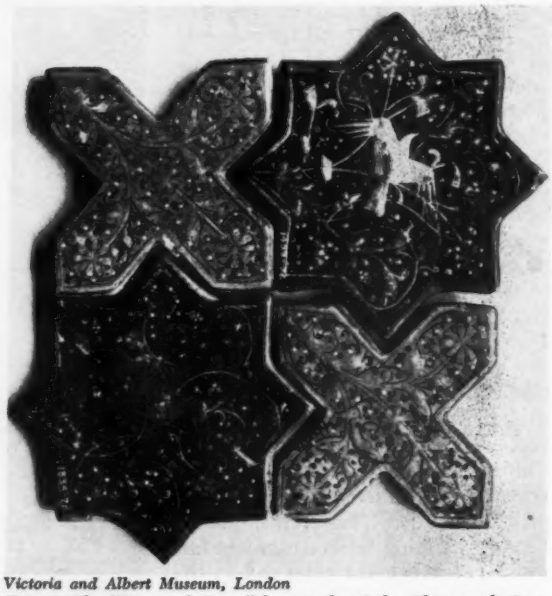


Victoria and Albert Museum, London

Fig. 6. The Thirteenth Century Persian lustered wall tile, above, typifies the brilliant glazed tiles which were unique with Persia and lustered in golden brown, changing to an iridescent film of green, purple, or ruby red in changing light.

Victoria and Albert Museum, London

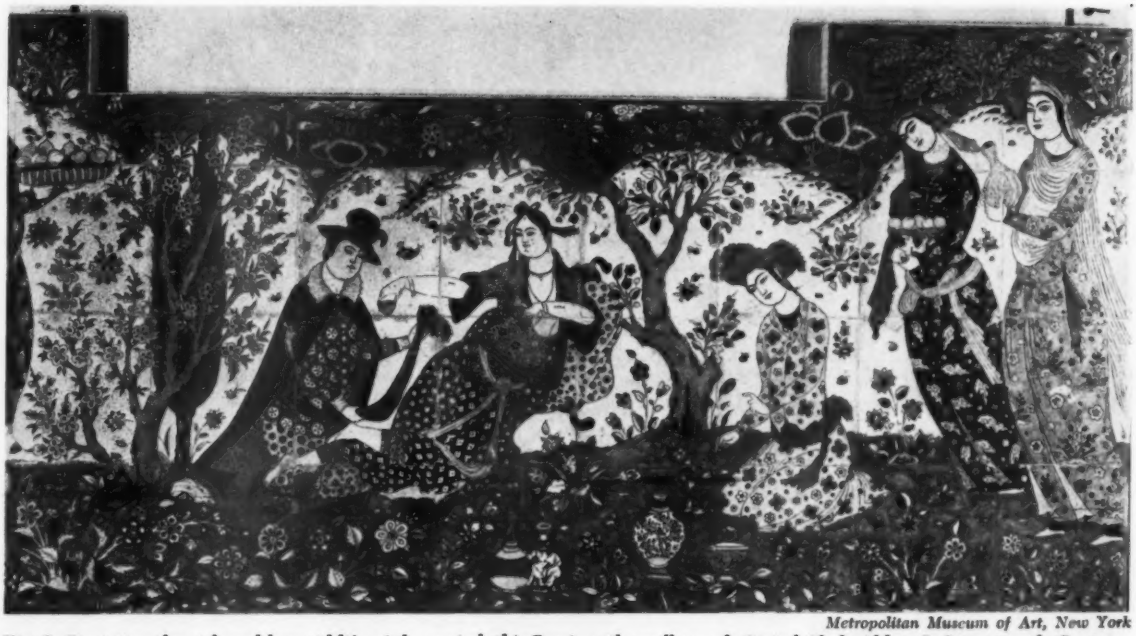
Fig. 7. Totally different from the painted tiles were the tile-mosaics, such as this Fourteenth Century Persian wall mosaic.



Victoria and Albert Museum, London

Fig. 8. The "Star and Cross" luster tile of the Thirteenth Century is characteristic of the combination of the eight-pointed star and the cruciform used by the Persians.

cord technique, later known in Spain as "cuerda seca," where either dry channels or purple pigment lines were placed between the different glazes on a single tile. Polychrome glazed faience panels of this type of tile were used on the walls of the royal palace in the famous capital of Isfahan during the reign of Shah Abbas I, 1585-1627. These panels of human figures depicted the rich and languid life of the period, well illustrated by the tile mural owned by the Metropolitan Museum of Art (Fig. 9), which shows the ladies of the court receiving bribes or presents from European merchants desirous of the Shah's favor.



Metropolitan Museum of Art, New York

Fig. 9. Depicting the rich and languid life of the period, this Persian tile wall panel, Period Shah Abbas I, Seventeenth Century, shows the ladies of the court receiving presents from European merchants desirous of the Shah's favor.

In the later work of the Sixteenth and Seventeenth Centuries, varieties of the painted panels were single tiles, with patterns in relief, showing figures of men hawking on horseback. Other tiles show busts of men and women painted on flat tiles, as in Fig. 10.

Little is known about the ceramic art of ancient Syria, for the Hebrews of Syria were a nomadic people, slow to adopt the art that surrounded their country.

In the later Saracenic period, Persian tilemakers found their way into Arabia, Egypt, Syria, and northern Africa where local schools of pottery were established. The Syrian tiles can be distinguished from those of Persia and Turkey by the rather coarse painted designs of arabesques, looped palmettes, and radiating motives based on the star, and the absence of red color. Turkey's part in the Moslem conquests started with the Ottomans and Seljuks who joined in the early crusades. Konia and Adrianople, in Asia Minor, became important ceramic centers until the capture of Constantinople in 1453 A.D.

At the height of its power in the Fifteenth and Sixteenth Centuries Turkey developed a national ceramic art and achieved great distinction for its decorative tiles. The victorious sultans, who fought against the Persians, brought back the craftsmen and we are told that Selim I, when he captured Tabriz and Kashan, moved 700 families of the best tilemakers to Isnik.

The tiles that lined both exterior and interior walls of the great mosques were unsurpassed for boldness of design and brilliance of color, and they endowed the inner walls, domes and mihrabs with special magnificence. The distinguishing color was a thick red obtained from a clay called Armenian bole and applied in the form of a slip.

The tiles were of simple geometrical shapes, cut faience mosaic and unexcelled mural panels (Fig. 11), painted with underglaze pigments on large areas of rectangular tiles. The best tiles were made from the clay of Nicaea (Isnik) coated with a transparent white glaze and a naturalistic rendering of flowers, all comparable to Chinese porcelain. The tile industry started to decline early in the Seventeenth Century and partially regained importance in the Eighteenth Century when Kutahia, largely populated by Armenians, became the center of tile manufacture.

Boston Museum of Fine Arts

Fig. 10. Persian painted portrait tile — Kowbacha, Daghestan, Sixteenth Century.

Victoria and Albert Museum, London

Fig. 11 At the height of its power in the Fifteenth and Sixteenth Centuries, Turkey achieved great distinction for its decorative tiles. Turkish tiles, such as this mural panel, were unsurpassed for boldness of design and brilliance of color, and were distinguished by a thick red color called Armenian bole.

Northern Africa and Spain

A brief historical background of the Moslems in North Africa and Spain starts in 711 A.D. when the army of the Omayyad, Caliph of Damascus, defeated the Teutonic Goths and occupied both Africa and Spain. Gaining a foothold in Europe, the Mohammedans surged through southern France to be repulsed by the Teutonic Franks, in the savage battle of Tours, 732 A.D., settling the fate of Christianity. However, it was not until 1492 that the last Moslem king of Granada surrendered to Ferdinand and Isabella, and Spain became a Christian country once again.

Tiles of Tunisia, Algeria, and Morocco were not only influenced by earlier work but were imported from Europe. Tiled minarets, unlike the circular forms of Persia and Turkey, were square in plan, rising to a crenelated parapet, with box-like cupola above. In Morocco some of the tiles were designed and glazed with tin enamel, in the manner of the Delft School, by Dutch slaves captured in the Seventeenth Century.

Strange as it seems, tiles were not extensively used in Spain until the Christians re-established their power. Many Moslems, called Mudejares, remained in Spain and their tilework naturally followed the Moorish style. In both public and private architecture, tiles were extensively used for decorating walls, steps, seats, and garden fountains; to have a house in Spain without tilework was a proverbial expression of poverty. Fine examples of this Fourteenth-Century work can be seen in the Alhambra and the churches and monasteries of Seville. The fact that the Moors of Granada held out for over two centuries after they had lost all of the other Spanish dominion, gave the kings of Granada the chance to build the famous Alhambra palace, which represents the highest achievement of Moorish art in Spain. Here glazed tile and colored plaster take the place of marble and mosaic.

Spanish tilework combined cut-mosaic, usually in geometric designs, with the method previously used in the Near East called cuerda seca (dry cord). Still another method appeared early in the Sixteenth Century, the cuenca (hollow) technique, where the design was pressed into the unfired face of the tile, leaving a raised outline that separated the colors. This and the cuerda seca technique allowed the reproduction of finer detail, such as the arms of the Pope, heraldry, candelabra, stylized leaves, flowers, and Renaissance designs.

Immigrant potters, among them being Francisco Niculoso of Pisa in Italy, came to Seville. Finding a popular enthusiasm for architectural decoration, they painted magnificent floral designs over panels of square tiles – a method influencing the later tilework of Holland.

In completing our survey of Spanish tiles, it is interesting to note, that previous to the Eighteenth Century, skilled potters from Talavera, Spain, had established a pottery at Puebla, Mexico. However, the Spanish influence was gradually tempered by the native Indian Aztec art.

Medieval Inlaid and Relief Tiles of Europe

In striking contrast to the brilliant wall tiles, so extensively used in the long period of Saracenic con-

Victoria and Albert Museum, London

quest, are the inlaid and relief tiles of Europe. They were used under the Norman rule, from about 1200 A.D. to 1500 A.D., when the church held great power and every effort was made to excel the splendor of the Italian ecclesiastical architecture. In the middle of the Eleventh Century mosaic workers had been brought to Italy from Constantinople and a type of pavement called *opus Alexandrinum*, combining large discs of colored marble, was developed. From these pavements, the first earthenware tile pavements of northern Europe were derived, especially in those countries where native stone and marble were not abundant. The relief tiles, favored by Germany and Switzerland, were decorated in raised relief, the designs often influenced by tapestry motives of Persia. Other tiles common to the German cities along the Rhine were five-inch unglazed gray and red floor tile, with incised designs of monsters associated with heraldry stamped on the soft clay. Pavements of tile-mosaic consisted of red and brown tiles, usually geometric in shape, coated with a yellowish lead glaze.

Inlaid tiles were also derived from a type of stone pavement, made by the French in the Twelfth and Thirteenth Centuries, where the design was drawn on the stone surface, cut out and filled with a darker colored substance. The tilemakers borrowed this idea, as shown in Fig. 12, and by means of a wooden die or sharp tool the design was struck into the moist clay. The impression was then filled with white or red clay, contrasting with the body color, and finally the tiles were glazed with transparent lead.

The technique of inlaid tilework was practiced with great success in England and the designs stand apart

(*Continued on page 166*)

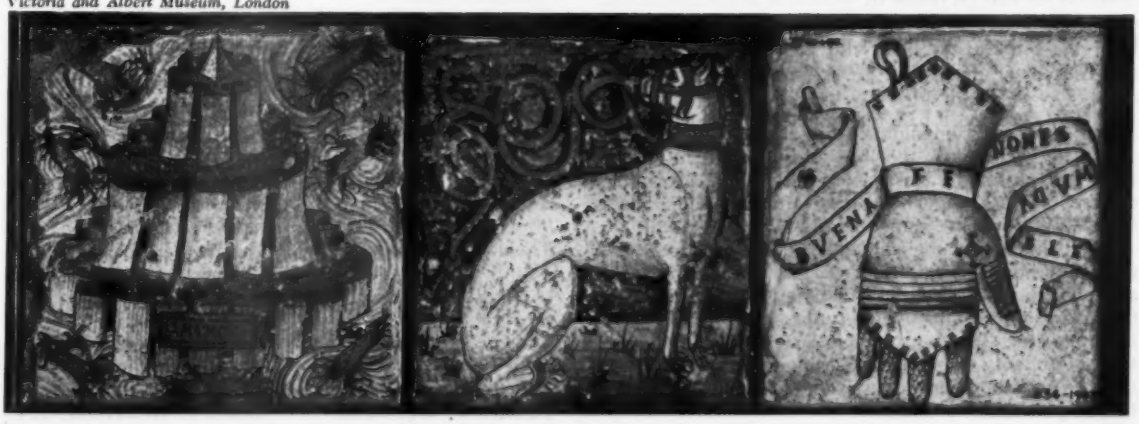
Fig. 12. (top of page) Fifteenth Century French inlaid tiles were derived from a type of stone pavement made in the Twelfth and Thirteenth Centuries.

Fig. 13. (bottom of page) Renaissance painted tile was known as faience or majolica ware. Depicted (left to right): a diamond surrounded by blazing fagots, with the word Amumoc (Blameless); *a leashed hound; a gauntlet with motto, "Good Faith Is Unchangeable."*

Fig. 14. (right) English inlaid tiles, such as these examples from Keynsham Abbey, depict mythological figures, heraldic emblems, and animals.

Victoria and Albert Museum, London

Victoria and Albert Museum, London



THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

M.I.T. Photo

Philip A. Stoddard, '40
Associate Placement Officer at M.I.T.

Associate Placement Officer

THE appointment of Philip A. Stoddard, '40, as Associate Placement Officer at the Institute was announced in November by Julius A. Stratton, '23, Vice-president and Provost of M.I.T. Mr. Stoddard has been assistant to Robert M. Kimball, '33, Director of the Division of Business Administration, since 1951. He will be succeeded in that position by John W. Sheetz, 3d, '42, who has transferred from the Lincoln Laboratory. In making the announcement, Dr. Stratton said:

Mr. Stoddard's appointment is an indication of the increased importance the Institute attaches to placement guidance and a closer relationship with the various representatives of industry and government who come to the Institute to select students for various positions.

We believe that the demand for our graduates will continue to be high, and that we have a real opportunity and obligation to place our graduates in positions where they can be most effective and where they will be most happy to stay. This can be done first, by more guidance to the students in selecting positions, and second, by close co-operation with industry and government in selection of personnel.

Mr. Stoddard, who is 36 years old, is the son of Florence (Menzies) Stoddard and the late Ralph C. Stoddard. He was graduated from Hingham High School in 1935 and from Phillips Exeter Academy the following year. He then entered M.I.T. which granted him the degree of bachelor of science in Business Engineering and Administration in 1940. After serving on the engineering staff of the Ingersoll-Rand Company of Phillipsburg, N.J., Mr. Stoddard served from 1940 until October, 1945, in the U.S. Army Ordnance Corps, 3rd Armored Division. He attained the rank of captain and served in the European Theater. After his war service, he returned to the Ingersoll-Rand Company for nearly a year before joining the staff of the Institute.

Of Technology Parentage

OUT of the Institute's 833 Freshmen this fall came 29 students whose fathers (and in one case, mother) are Alumni of M.I.T. A campus far different from that of the 'twenties and 'thirties greets those of Technology parentage listed below – but a campus that continues to hold the intangibles which produce the basis for a sound engineering and scientific training.

Student	*Parent*
Chester C. Bannister	Alfred E. Bannister, '15 (deceased)
Jay R. Bonnar	J. Robert Bonnar, '27
Robert G. Bridgham	Minot R. S. Bridgham, '32
Edgar H. Bristol	Benjamin H. Bristol, 2d, '19
Peter C. Card	Thomas B. Card, '21
Armand E. Cherniack	Nathan Cherniack, '22
Ralph deJ. Dopmeyer	Arthur L. Dopmeyer, '20
Paul R. Duevel	Charles O. Duevel, Jr., '24
A. Wentworth Erickson, 3d	A. Wentworth Erickson Jr., '28
Lee B. Freese	Simon W. Freese, '21
Donato A. Grieco, Jr.	Donato A. Grieco, '31
Robert P. Holton	John H. Holton, '17
Norman P. Howard	Alan F. Howard, '18
Richard P. Hurlbut	Terry A. Hurlbut, '28
Malcolm M. Jones	S. Murray Jones, '21
Albert S. Klainer	Ruben H. Klainer, '24
Charles deG. Koch	Fred C. Koch, '22
John E. Marsland, Jr.	John E. Marsland, '32
Philip B. Mitchell	Ronald A. Mitchell, '25
George Moy, Jr.	George Moy, '31
Russell M. Peirce, Jr.	Russell M. Peirce, '20
Alan Phillips	Charlotte T. (Mrs. Henry B.) Phillips, '26
Thomas S. Roberts	Claudius H. M. Roberts, '17
William C. Salmon	Chenery Salmon, '26
Lewis R. Smith	R. Barlow Smith, '33
Thomas L. Springall	Cyrus F. Springall, '12
Henry K. Uman	Abraham S. Uman, '30
K. William Waterson, Jr.	Karl W. Waterson, '98
Richard V. Westerhoff	Russell P. Westerhoff, '27

Chemical Engineering Procedures

TWENTY members of the faculty in the Department of Chemical Engineering met with Karl T. Compton, Chairman of the M.I.T. Corporation, James R. Killian, Jr., '26, President of M.I.T., and Edward L. Cochrane, '20, Dean of the School of Engineering, together with five members of the Visiting Committee on the Department of Chemical Engineering at Cambridge on March 20, 1953.* A broad range of topics was covered in this full day meeting. The extensive report of this Committee, released for publication in The Review on July 29, must necessarily be considerably condensed here. It is believed that the sense of the Committee's views are retained in the following editorial condensation, however.

The meeting was opened by a discussion of the educational philosophy of the Department. Charles A. Thomas, '24, pointed out the need for the Institute to question, from time to time, whether it is turning out better chemical engineers than in the past. The development of judgment and a sense of responsibility constitute an important part of college training, and these traits can be developed most effectively by close personal contact between students and experienced Faculty members. It was agreed that the best interests of the nation require that educational institutions give first priority to the training of their students. It is recognized that Faculty members may have important obligations to serve the nation as technical experts or as government administrators, but such activities are to be regarded as short-term gains as compared to the long-term gains attained through undergraduate and graduate training in science and engineering.

The faculty is engaged in internal and external committee and advisory work to a much greater degree than 15 years ago. Each such activity can be justified, but in the aggregate such duties require a great deal of time; they tend to limit opportunity for professional advancement on the part of the faculty, and curtail time for student-faculty contacts. Hence, the need arises for maintaining a proper balance of the working load on the faculty.

J. Edward Vivian, '39, Associate Professor of Chemical Engineering, reported on activities of the Department's two practice schools: the chemical engineering practice school with stations in Lackawanna, N.Y., South Brewer, Maine, and Parlin, N.J.; and the atomic energy practice school, established in 1948, at Oak Ridge, Tenn. The first of these constitutes a part of the graduate program of the Department. The Oak Ridge practice school is intended for graduate students in all branches of engineering, but attendance has been mainly by chemical, and a few mechanical, engineers. Both practice schools give students an opportunity to become well acquainted with industrial problems, and all stations are in good physical condition. Both practice schools have facilities for more students than have been registered of late. The purpose of the Oak Ridge practice school can be fulfilled more effectively by increasing the number of students, from other courses, who take advantage of available facilities.

A discussion of undergraduate education brought forth expressions from the faculty that it was impossible to cover all topics industry would like to have taught, even if the Chemical Engineering program were extended to five years. It was the general feeling that the best course to follow in teaching chemical engineering was to limit the course to four years and to emphasize fundamentals. Those students who feel the need for, and who have the capacity to benefit from, additional training could continue at the graduate level. Such a procedure could overcome objections of over-departmentalization and could well have, as its major objective, the building of a flexible mind in students.

Present enrollment in Chemical Engineering at the Institute is at about the prewar level but is increasing. It is anticipated that in a few years there will be a 50 per cent increase above prewar figures in the number of graduates in Chemical Engineering. Graduate School enrollment has dropped in the last few years.

Operation of the new course in nuclear engineering was discussed in considerable detail. Much interest has been shown in nuclear engineering by graduate students. Those mainly interested are a group of naval students from the Bureau of Ships, physicists, and chemical and mechanical engineers. A more integrated curriculum than now exists is desirable for this undergraduate course, however.

A proposed course of graduate study leading to the master of science degree in nuclear engineering has been prepared, and the Committee agreed with the desirability of offering a master's degree in nuclear engineering. Nevertheless, it was recognized that there is, as yet, little demand for graduates with such a degree. Before industry takes an interest in applications of atomic energy, the law concerning fissionable materials and operating difficulties for processing such materials would have to be changed.

In dealing with the topic of future employment prospects for graduates of Course X, the members of the Visiting Committee were in agreement that the demand for chemical engineers would probably continue at a high level for the next several years, especially for those with good sound training in the field.

* Members of this Committee for 1952-1953 were: Charles A. Thomas, '24, chairman, Bradley Dewey, '09, Edward S. Farrow, '20, William M. Stratford, '21, David A. Shepard, '26, Robert B. Semple, '32, and Ralph G. Follis.

Plant Physiology

CURRENT experiments dealing with the way in which plants live, grow, and develop were discussed by Kenneth V. Thimann, Professor of Plant Physiology at Harvard University in a lecture — "The Physiology of Growth in Plant Tissues." M.I.T.'s chapter of the Society of the Sigma Xi, the national honorary society for the encouragement of scientific research, sponsored the lecture at the Institute on December 1.

A native of England, Dr. Thimann holds degrees from the Imperial College of Science and Technology, London, and the University of London. He came to the United States in 1930 to become instructor in biochemistry at the California Institute of Technology and has been at Harvard University since 1935. From 1946 to 1950 he served as director of the Harvard Biological Laboratories.

Ancient Shipwrecks

WITH 175 members and guests attending, the 299th meeting of the Alumni Council at the M.I.T. Faculty Club on Monday, November 30, 1953, was the largest on record, and was devoted to discussion of scholarship aid, research obligations to the industrial community, and photographs of submarine life and sunken treasures. Horatio L. Bond, '23, as President of the Alumni Association, opened the dinner meeting with a routine of business in which the minutes of the October 26 meeting were approved, Donald P. Severance, '38, as Secretary of the Association, reported that two changes of class affiliation had been approved and that, between October 28 and November 20, nineteen members of the M.I.T. staff had visited 27 M.I.T. clubs.

Stanley C. Dunning, '17, chairman of the Midwinter Meeting Committee, reported that this year's Midwinter Meeting would be held at Walker Memorial on Thursday, February 4. Following a steak dinner, James R. Killian, Jr., '26, President of the Institute, will address Alumni on Technology affairs, and Horace S. Ford, M.I.T. Treasurer Emeritus, will act as master of ceremonies in a program in which one speaker from each of the Institute's three neighbors along "Research Row" will speak: one from Godfrey L. Cabot, Inc., one from Arthur D. Little, Inc., and one from the National Research Corporation.

Henry B. Kane, '24, Director of the Alumni Fund, reported that, as of November 30, a total of $80,000 had been contributed by 4,141 Alumni.

President Bond then introduced Karl T. Compton, Chairman of the M.I.T. Corporation, who spoke on financing a college education. Sometimes well-qualified applicants who are admitted to the Institute fail to register. A survey of such cases often discloses that failure to enter college may be traced to lack of scholarships; in other cases, a student may enter some other educational institution if scholarship aid from that university is more attractive than that which M.I.T. is able to provide the student. Last year the Sloan Foundation established a number of scholarships, ranging in value from $200 to $2,000 for students entering M.I.T., California Institute of Technology, Carnegie Institute of Technology, and the Engineering School of Cornell University.

Next, William R. Weems, '35, was asked to describe the operation of the Industrial Liaison Office, of which he is director. Mr. Weems defined the purpose and scope of the activities of his office as follows: "The Industrial Liaison Program is a device for providing convenience of access to M.I.T.'s research program, and every other reasonable consideration within the existing ethical and traditional framework of the Institute, to a certain group of companies which are affording M.I.T. financial support of an essentially unrestricted character." Toward this end, the Industrial Liaison Office is engaged in distributing certain technical publications, in administering special conferences and symposia, and arranging for special visits for the firms participating in the Industrial Liaison Program. The activities of the Industrial Liaison Program differ from those of the Division of Industrial Coöperation (which handles contract research) and also from programs of grants-in-aid (in which a specific field of research is sponsored) through unrestricted financial support for the academic budget.

Professor Harold E. Edgerton, '27, of the Department of Electrical Engineering, next showed his excellent colored movies and slides taken during the past summer while aboard the ship *Calypso* with Jacques Costeau, whose underwater exploring is described in his recent best-selling book, *Silent World.** Professor Edgerton was primarily concerned with experimenting with his newly developed electronic-flash equipment for deep-sea photography and with the photographic investigation of the deep scattering layer – for which he had a grant from the National Geographic Society and equipment built at M.I.T.'s Research Laboratory for Electronics. However, he devoted most of his talk to the day-by-day shipboard action of raising cargo from an ancient Greek galley sunk in 230 B.C. off the coast of Marseille, France; searching for other ancient shipwrecks; and pictures and explanations of such discoveries as dishes and Roman and Greek amphorae (one even containing its original wine of 2,200 years ago).

Qualifications for Chemists

MORNING and afternoon sessions of the Visiting Committee on the Department of Chemistry† were held in the Moore Room at M.I.T. when the Committee met on March 1, 1953. Karl T. Compton, chairman of the Corporation, and James R. Killian, Jr., '26, President of the Institute, joined the group for part of the meeting. Arthur C. Cope, Head of the Department, and Leicester F. Hamilton, '14, Executive Officer, discussed various problems with the Committee; faculty members reported on current research programs and discussed undergraduate and graduate curricula in physical chemistry.

One of the questions raised was the possible reduction of laboratory work in physical chemistry for students in Chemical Engineering. It was the opinion of the Committee that the laboratory work in physical chemistry for chemical engineers should not be reduced below the present level of four hours every other week, even if the alternative were to cut organic chemistry laboratory work – the feeling being that firsthand experience in accurate measurements in the field of physical chemistry was of prime importance in developing good chemical engineers. This assumes, of course, that the laboratory course is well planned for the needs of the chemical engineers.

In connection with M.I.T.'s program to reduce the number of "contact hours" in the freshman year, the Committee was not in favor of cutting the laboratory requirement for freshman chemistry from three to two hours a week. While the present schedule represents a considerable number of contact hours, the laboratory atmosphere is informal, and if students learn to plan their work it is usually finished within less than three hours. Time is required to assemble

(*Concluded on page 158*)

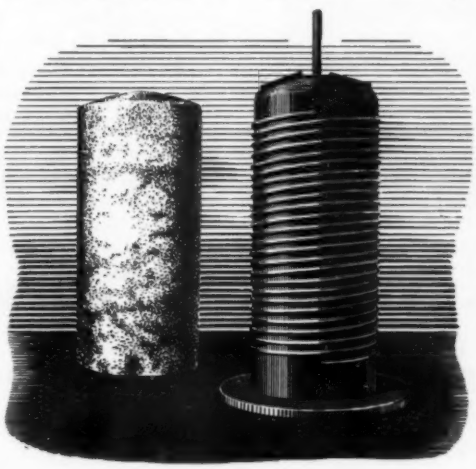
* New York: Harper and Brothers, 1953.

† Members of this Committee for 1952-1953 were: Pierre F. Lavedan, '20, chairman, Robert E. Wilson, '16, Crawford H. Greenewalt, '22, John M. Gaines, '26, John G. Kirkwood, '29, William M. Holaday, and Paul L. Salzberg.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Titanium melts at 3140°F., and copper at 1980°F. Hence most people would think it utterly impossible to melt titanium in a mold made of copper. Yet it is being done on a production basis. The trick is to make use of the high thermal conductivity of copper. The copper mold has a copper baffle wrapped in a spiral around it, and is inserted in a water jacket. Water is pumped at high velocity through the jacket, and spirals around the outside of the mold. Heat from the molten titanium is transferred quickly and efficiently by the copper to the water, and thus carried off. The copper never comes close to its melting point.



This remarkable application of copper is just a part of the tremendous activity in the field of titanium. Many companies are seeking ways to produce metallic titanium in large tonnages and at reasonable prices. Among other applications, it is used in certain jet engine parts that are subjected to high temperatures and the impact of gases that are moving at terrific velocities.

Eventually ways will be found to produce titanium in large volume at practical prices. This will be a great boon. It is the fourth most abundant metal in the earth's crust, only aluminum, iron and magnesium being present in greater amounts. It can be easily forged, welded, and hot worked. There is every indication that it is a metal with a tremendous future.

Copper is man's oldest metal, and titanium the newest. In this ingenious copper mold the old assists in the birth of the new. Copper serves in this way so often that for many years we have called it "the metal of invention." It helped make possible the telegraph, the telephone, electric light and power, and the multitudinous electronic devices used in communications, calculation, and medicine. For many centuries man has sought and found new ways to take advantage of copper's unique qualities.

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THE INSTITUTE GAZETTE

(*Concluded from page 156*)

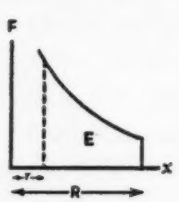
apparatus, and the reduction of the laboratory period to two hours would decrease its training value.

The Committee discussed the fact that the demand for M.I.T. trained chemists exceeded the number of men specializing in undergraduate chemistry. However, as certain interests and aptitudes are needed to make a good chemist, it was felt that efforts to encourage more students to enter Course V should be limited to making sure that the undergraduate teaching was of a character and quality likely to arouse the interest and enthusiasm of those who were by nature qualified for such work.

The graduate work in Chemistry attracts more students than the undergraduate course; in fact, the number receiving doctor's degrees is somewhat greater than the number receiving the B.S. from the undergraduate course. There is no difficulty in getting a full quota of well-qualified candidates from other institutions for graduate work and, in general, it seems better for men to take their undergraduate and graduate work in different schools.

In general, the Committee felt that the Department has an able staff and was making definite progress in both teaching and research.

The report of the Committee, as condensed in the preceding paragraphs, was made available for publication in The Review on August 6, 1953.



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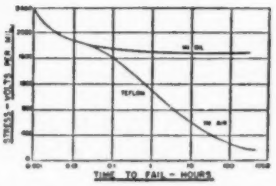

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PFGV-5	20	7	12000	.205	.074	.60	403	162	100.00
PFGV-13000-14	14	41	13000	.240	.075	1.13	319	173	115.00
PFGV-7	20	7	13000	.280	.100	1.86	380	130	115.00
PFGV-15000-16	16	19	15000	.280	.092	1.48	373	163	125.00
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PSYCHOLOGY, THE MACHINE, AND SOCIETY

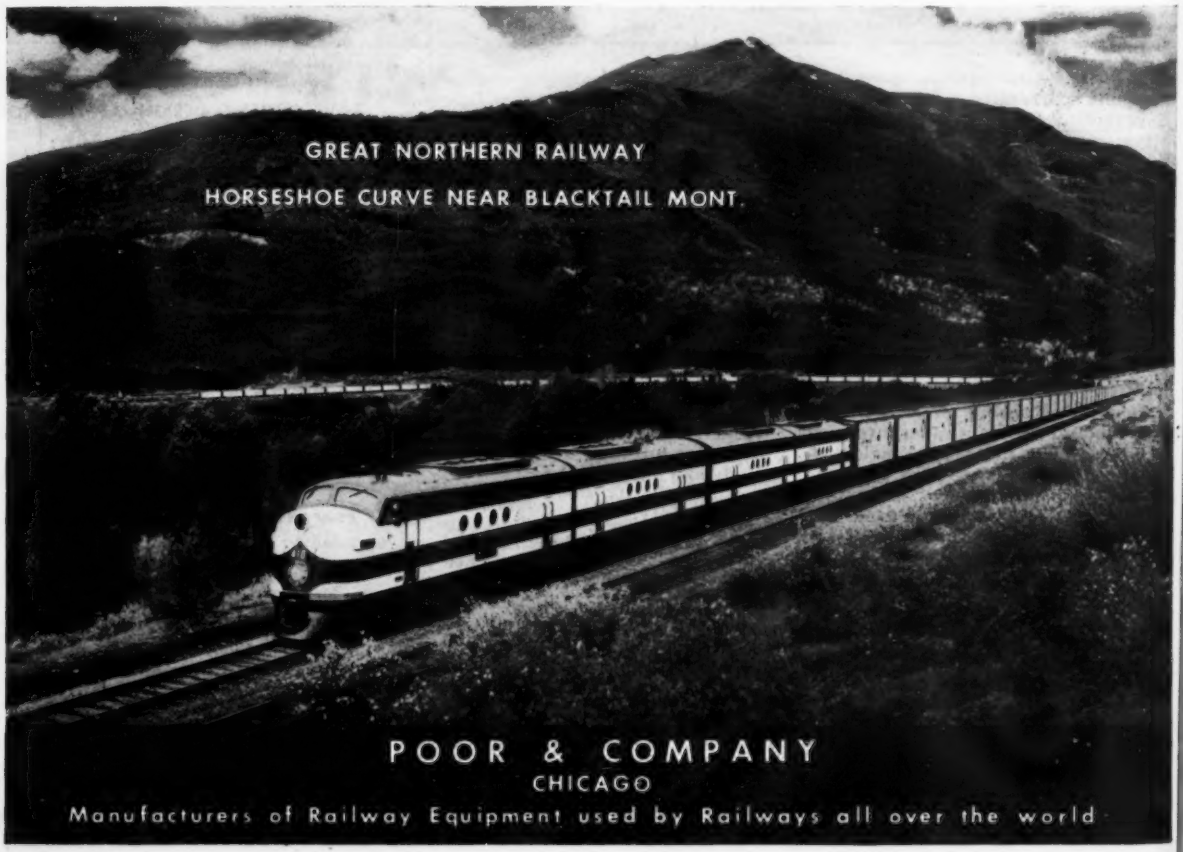
(*Continued from page 144*)

of the economic criterion, which was destroying the quality of the popular Ideal." Dr. Kirk summarized Keynes as asserting that "the final *reductio ad absurdum* of Benthamism is known as Marxism; drained of spirit and imagination by the gross objectives of the Utilitarians, we have ended defenseless before this brutal descendant of Bentham's philanthropy."

In many places today, therefore, a new conviction is growing that what ails our age is not some ancient political, economic, or social cancer, but rather a loss of the old understanding that virtue in the individuals who make up society is basic in creating a good, just, free, and achieving social order. The rash theorists and self-seeking politicians who have attacked existing organic social orders have often sneered at this age-old idea. For example, many of the self-styled liberals of the Nineteenth Century believed that a society could exist without religion, but this assumption has never been demonstrated through a series of generations. They also underestimated the importance of the slowly evolved traditional wisdom of mankind and the power of custom, that universal gyroscope of society, in the effective control of human beings and especially in the ordering of the lives of those of limited capacity in the use of abstract verbal principles. Practical ideals and a fixed scale of human values were recognized, taught, and acclaimed, if not always lived up to, by the old system. Politeness and courtesy, sometimes called the minor morals or the lubricants of society, also were handed down from the past to make social living more pleasant. All too often these intangible — and in some respects truly spiritual — characteristics of man's ancient morals were thrown out by would-be reformers with their superficially mechanistic ideas. There were, to be sure, injustices and inequities in all the old orders of society. But those who saw reform as the mere provision of more and more superficial entertainment and greater and greater idleness for larger and larger groups of people were set, it now appears, on copying the worst and not the best of the old society they were trying to overturn. As hours of work were decreased and pay increased, the economic feasibility of skilled handwork and its consequent artistic satisfactions to the worker were largely lost. It is a sad commentary that sometimes this precious new leisure has been occupied by activities no more constructive than wagering on dogs as they run after mechanical rabbits on a track.

Thus we return to the strange fact that men who have learned to release atomic energy, to bounce signals back and forth from the moon, to banish typhoid and yellow fevers, and to make electronic calculators do the work of tired brains, have failed to maintain the best intrinsic satisfactions, the highest ancient ethical and moral values and spiritual insights, in a changing society. It is all too clear that some of the

(*Continued on page 162*)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PSYCHOLOGY, THE MACHINE, AND SOCIETY

(*Continued from page 160*)

would-be doctors of society, unlike modern scientific physicians, failed to recognize that human beings are not all alike and that they have inborn characteristics that must be dealt with by those who would effectively improve society.

We are faced back to the conclusion that the basic psychology of those parts of human nature that are inborn ought not to be forgotten by the successful social engineer any more than the properties of metals can be disregarded by one who plans to construct a good television receiver. As Lewis Mumford once put it, in an address before the American Association for the Advancement of Science: "The tendency to overlook the human end which our automatic organizations serve has begun to pervade our whole civilization; and in the end, if it is uncorrected, it may effectually undermine our best achievements. . . . No matter how marvelous our inventions, how productive our industries, how exquisitely automatic our machines, the whole process may be brought to a standstill by its failure to engage the human personality or to serve its needs."

Radical social reformers have often tried to pretend that biological heredity was not important in psychology. William Godwin, a most fixed-eyed and unrealistic but strangely influential social reformer of the late Eighteenth Century, believed in the perfectibility of the human race in one generation if the environment could only be changed in the right way. Many later would-be reformers have unthinkingly accepted this view. Even the great John Stuart Mill suggested that anyone who believed in inherited traits was an advocate of social reaction. In our own time this old scientific heresy, that inborn differences between men of the sort measured by aptitude tests do not exist, is still proclaimed as a new truth in Russia. In holding this position at least at the verbal level, the steel-handed present-day Russian Communists are walking in the path of the visionary Nineteenth Century melioristic reformers who preceded them. Intelligence tests in education are now proscribed by Moscow. Such measuring devices are said to demonstrate differences that cannot exist in the so-called perfect environment of a communist state. It would be interesting to know through what back door a realistic recognition of inborn individual differences is now introduced in Russian education. That such

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differences exist in Russia, as well as in America, is as sure as is the existence of chromosomes. It is true, of course, that modern psychology must deal with both inborn and culturally determined traits, for ordinarily both chromosomal determination and environmental forces co-operate in producing each physical or mental performance of every person. But to ignore inherited differences in individuals is to close one's eyes to most important facts.

Is it not fair to say, therefore, that one of the worst mistakes of the superficially mechanistic reformers of society has been their willingness to forget that society is made up of individual free organisms with conservative and yet varying brains and muscles? To put this in another way, is not a good society made up of bad individual men impossible? Certainly this is true, in spite of the satirical arguments of such tongue-in-cheek philosophers as Bernard de Mandeville who have attempted to assert that private vices make public benefits. A group of people of varying inborn abilities but alike in trying hard to be honest, unselfish, charitable, virtuous, diligent, self-reliant, and full respecters of private property, would not need to worry too much about external social or economic reform.

This point of view makes it clear that what Peter Viereck has well called the "revolt against revolt" should now challenge our full attention. Have we not been living too long in a world that has tried to pretend that social upheaval is always social progress? Destructive social reformers often have sweet-tasting and mysterious medicines to propose. Such men in our time begin by suggesting new legislation that seems to give something for nothing. Harold Laski, for example, always could attack what he called "privilege" as he advocated more socialization of industry. Envy may for a time be a satisfactory motive to be used by the selfish demagogue to get votes, but it is a bad sentiment on which to build a stable and achieving society. When legislation does not produce the results hoped for by the reformers, more and more police action is demanded. Those, however, who see that the organic structure of society must be maintained and slowly made better by improving the personal character of individual human beings are at a disadvantage in combating the schemes of the wholesale destructive advocates of social change. Those who believe in self-discipline first have no simple and easy patent medicine to prescribe. All that such conservative and true reformers can suggest is more adherence on the part of more people to the highest

(*Continued on page 164*)

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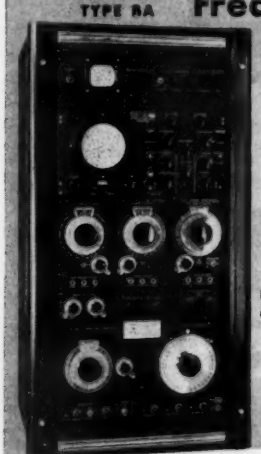

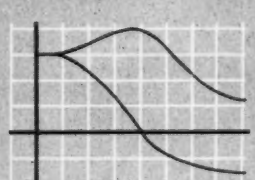

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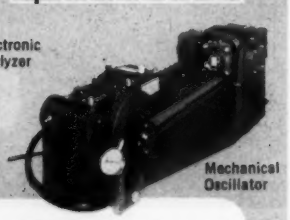

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PSYCHOLOGY, THE MACHINE, AND SOCIETY

(*Continued from page 163*)

ethical and religious teachings, and more of the right sort of education fitted for individuals of differing interests and inborn talents. Social improvement of this sort is usually within the reach of every individual, but it requires first the hard work of self-reform and not the iconoclastic fun of pulling down others who externally seem more fortunate or who have been more diligent and thrifty.

When we think here of the education of individuals, let us not forget that the objectives of education are in the last analysis socially determined. In our political democracy and our tested and effective, competitive, free, capitalist economy we all have a responsibility to see to it that our schools foster an education that makes possible the discovery of truth and the achievement of individual intellectual liberty. Harvard University's now justly famous book *General Education in a Free Society*[4] wisely begins with these words of Plato: "Youth is the time when the character is being molded and easily takes any impress one may wish to stamp on it. Shall we then simply allow our children to listen to any stories that anyone happens to make up and so receive into their minds ideas often the very opposite to those we shall think they ought to have when they are grown up?"

If this statement from the *Republic* is accepted, we are today challenged to re-examine the question as to whether, under the influence of a shallow and often misunderstood positivism and an incomplete naturalism, American education has not in the past generation turned too sharply away from all instruction that had as its aim the inculcation of fixed systems of values. If a free and stable society depends on citizens who act as they do because they are trying hard to live up to high ethical standards, then let us do what we can to raise up new generations that know what these standards and scales of values are.

It is easier, of course, to talk about the teaching of ethical and even aesthetic values than to say how such instruction should be given in a free democracy. Certainly, however, an education aiming to accomplish such ends will emphasize studies that acquaint the members of each new generation with the true wisdom of the race concerning the best ways in which

[4] *General Education in a Free Society* (Cambridge: Harvard University, 1945).

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men can react to one another. The study of biology, anthropology, sociology, economics, political science, social history, psychiatry, and psychology will help in providing a basis for this understanding. But these fields alone will not provide the needed humanistic value scales because in their very nature these sciences must be objective and factual.

The conclusion seems forced upon us, therefore, with new inevitability that an education which is to make free, sensitive, socially responsible individuals with self-accepted value systems must emphasize the great body of studies, such as religion, law, history, and literature, that represents the noblest human wisdom of the past — "the best that has been thought and said in the world." To put this in another way, it seems that the education of individuals who are to have the persistence, the courage, and the stamina to reform themselves before they try to reform society will require a sympathetic study of the best parts of those strands of our intellectual tradition which we call the humanities.

This conclusion, of course, is not novel. Students here at M.I.T. are naturally and most properly offered unsurpassed opportunities to study the physical sciences and the whole range of modern applied technologies. In recent years, however, under the far-sighted educational statesmanship of Karl T. Compton, Chairman of the Corporation, and James R. Killian, Jr., '26, President of the Institute, this world-renowned scientific research institution has emphasized basic instruction in the humanities. Thus an effort is made to have students here become not only scientists and technologists but also wise human beings who understand the intellectual, artistic, and spiritual traditions and values that mankind has gradually beaten out for itself through the ages. This fortunately is a point of view in higher education that today is sweeping to new recognition everywhere in America. The old destructive educational revolution of the last generation that tried to banish values from school and college work is being unmasked as a destroyer of much that was of first importance to a society.

In this great institution, and in others like it that are hospitable to many foreign students, it is good that this new point of view is being emphasized. Visiting students from other lands and cultures should not only be given our mathematical, scientific, and technological skills, but also should learn the true spiritual wisdom of our free Western world at its best.

(Concluded on page 166)

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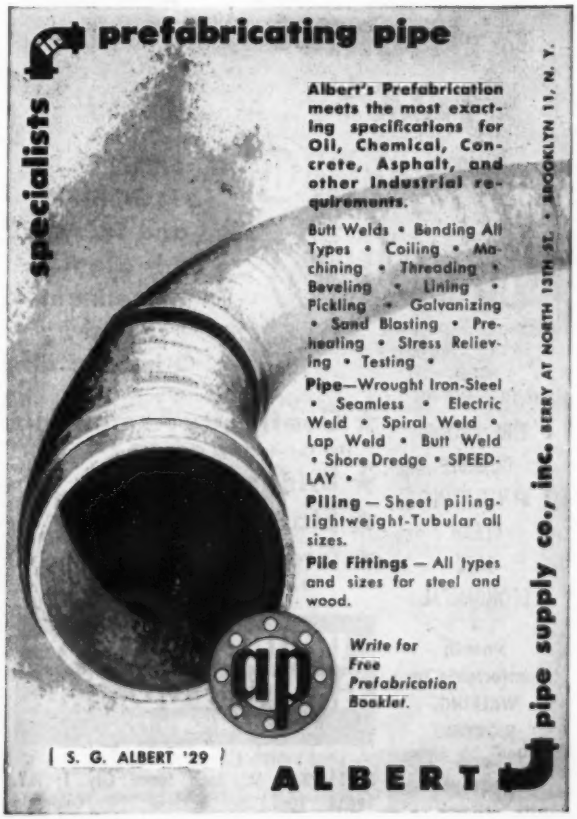
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PSYCHOLOGY, THE MACHINE, AND SOCIETY

(*Concluded from page 165*)

Therefore, in recapitulation, as we think of psychology, the machine, and society, a few basic conclusions emerge. Science in a most general sense has given great sections of modern men a high standard of living and an opportunity to provide themselves a life of health and comfort undreamed of in any ancient utopia. Further progress of this kind may be confidently expected if social and international disorder does not prevent it. Modern psychology, although still far from being able to provide final answers to all relevant questions, does show that man's understanding of his inborn and acquired make-up is important for technology and an understanding of society.

In spite of these demonstrated advances, pessimism about society is a dominant attitude of many thoughtful people in our day. Recent social upheavals aggravate this gloomy stand. Is it not conceivable, however, that in their faith in the possibility of social progress, Victorian intellectual leaders were nearer the truth than are some of our modern writers?

Man's mammalian characteristics are millions of years old, but man as a free intelligence is built to live in the future. The pilots of the atomic-powered airplanes of the year 2000 will have essentially the same conservative brain and muscles that our fathers possessed. Nevertheless, our growing knowledge of psychology, the machine, and society seems ready to help us make such future pilots and others of their generation ethically and socially wiser and more satisfied with life than we are. If we are to approach this better state it seems clear that we must be prepared to spend more money and thought than in the past on improving the quality of the instruction we offer to all the youth of our race. If we hope to have a finer and more achieving society, education fitted to the aptitudes of each individual is a most promising tool. As we plan for the future place of education in our social order, let us have the courage to act as though we believe that the golden age is ahead and not behind!

DECORATIVE TILES

(*Continued from page 153*)

from those of continental Europe. These English tiles are one of the most interesting materials of the Gothic period and though somber in color, the designs were masterpieces of the medieval tilemakers. We can be reasonably sure that these tiles were made within the precincts of the monasteries. Confirmation of such a view can be found in the discovery of tiles in the Chapter House of Castleacre, in Norfolk, where there were said to be 39 monks and 48 benefactors. The motives combined geometrical combinations, conventional foliage, animals, heraldic emblems, and mythological figures, such as the griffin and the centaur, as shown in Fig. 14. Examples of this tilework have been found in the medieval cathedrals, parish churches, and abbeys, such as the great Malvern Pri-

(*Concluded on page 168*)

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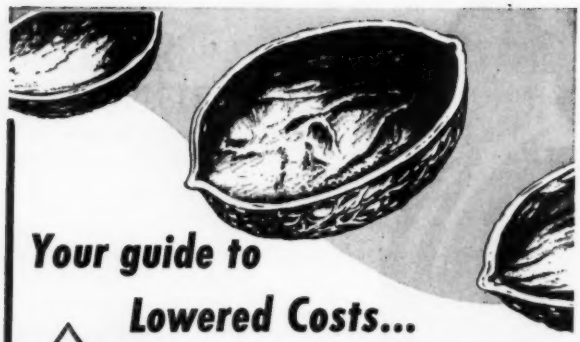

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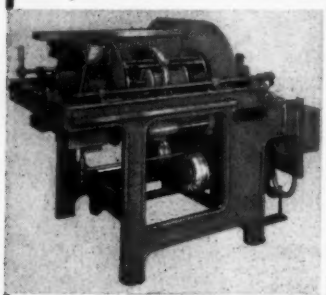

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DECORATIVE TILES

(*Concluded from page 166*)

ory, the cathedrals of Gloucester and Westminster, the abbeys of Chertsey, Halesowen, and Keynsham. The cessation of this work dates from the Reformation, when the monasteries were dissolved and the craftsmen dispersed.

Renaissance Painted Tiles

When the Gothic influence drew to a close, the tilemakers turned to the Renaissance of Italy for their inspiration. This movement started in the Thirteenth Century but it was not until the Fifteenth and Sixteenth Centuries that it attained its greatest development. Art and science led to social distinction, and the expression of individual talent and realism took the place of medieval obedience to the power of God; all of which was reflected in the painted tiles. These tiles (Fig. 13) were known as faience or majolica ware, the painting being applied over a stanniferous enamel. Public taste of the time can be judged from the following saying attributed to one of the clergy: "The inferior part of man will be in favor of Eastern porcelain, but the rational and intellectual will guide him to maiolica." It was unfortunate that these tiles were not used for wall decoration, for the soft glaze was not suitable for floor use and the designs were destroyed by constant wear.

The tile painters were tempted to copy the work of the great masters, and inspiration came from such painters as Leonardo da Vinci (1452-1519), Michelangelo (1475-1564), Titian (1477-1576), Raphael Sanzio (1483-1520), and many others.

The idea of painted tiles for pavements was carried to Germany and Switzerland during the Sixteenth Century and the technique was soon adopted by the makers of stove tiles. The spirit of the Renaissance almost vanished in the Seventeenth Century and it remained for the Netherlands to revive the use of tin-enameled tiles for wall decoration.

Part II – "Decorative Tiles," covering the tilework of Holland, England, and the United States, will be published in the February, 1954, issue of The Review.

YELLOW FEVER'S ROLE IN HISTORY

(*Continued from page 146*)

fever, and others – as against only 400 deaths in battle. The depredations of yellow fever were so great in Cuba that at one time General Leonard Wood seriously considered withdrawal of his forces from the fever-ridden island in order to avert a disaster similar to that which had overcome the French in Santo Domingo.

By this time the mosquito was suspected but not proven as the carrier of yellow fever. As early as 1848 a wise doctor of Mobile, Ala., Josiah C. Nott, had suggested that insects, probably mosquitoes, were the vectors of yellow fever. In 1881 Dr. Carlos Finlay

(*Concluded on page 170*)

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YELLOW FEVER'S ROLE IN HISTORY

(Concluded from page 168)

of Cuba declared that mosquitoes were responsible. Already, in 1879, Sir Patrick Manson had shown that mosquitoes of a certain species carried the disease known as filariasis, and in 1898, Sir Ronald Ross, brilliantly demonstrated that malaria could be spread only by mosquitoes of the Anopheles tribe.

Conquest

The rest of the story is well known. In 1900 Surgeon General George M. Sternberg of the Army appointed a board, headed by Major Walter Reed, to investigate the cause of yellow fever. With his associates, Drs. James Carroll, Jesse W. Lazear, and Aristides Agramonte, Major Reed began operations in Cuba and soon demonstrated that yellow fever is disseminated only by mosquitoes of a species then known as the *Stegomyia fasciata* and now more appropriately called the *Aëdes aegypti*. These famous experiments, in which Dr. Lazear lost his life, made possible the eventual conquest of yellow fever.

Equally well known is the sequel to this story; how Colonel, later Surgeon General, William Crawford Gorgas applied the facts made known by Walter Reed to conditions in Havana and later in Panama. Yellow fever had defeated the French under de Lesseps in their attempt to build a canal across Panama between 1880 and 1887, but the successful elimination of yellow fever and malaria in this area by Gorgas and his associates made possible the completion of this essential waterway by the United States.

In this noteworthy instance it was the conquest of yellow fever which unrolled a new map, just as a century and a half earlier it was yellow fever itself which charted a new territory for the United States.

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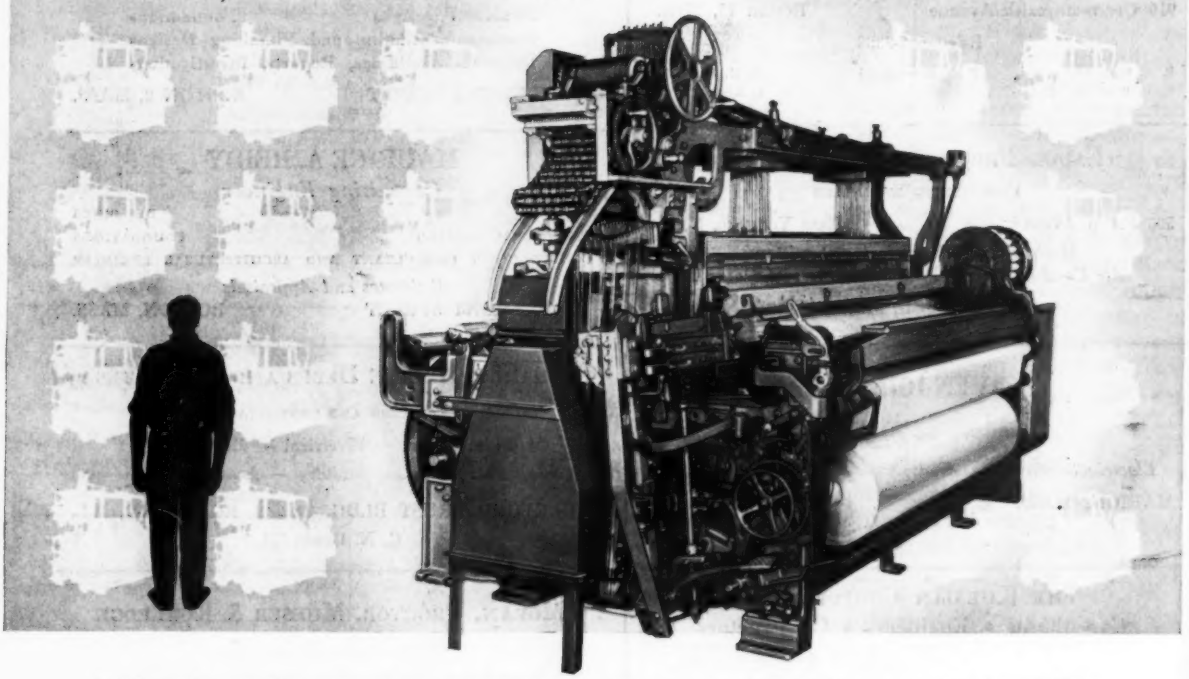

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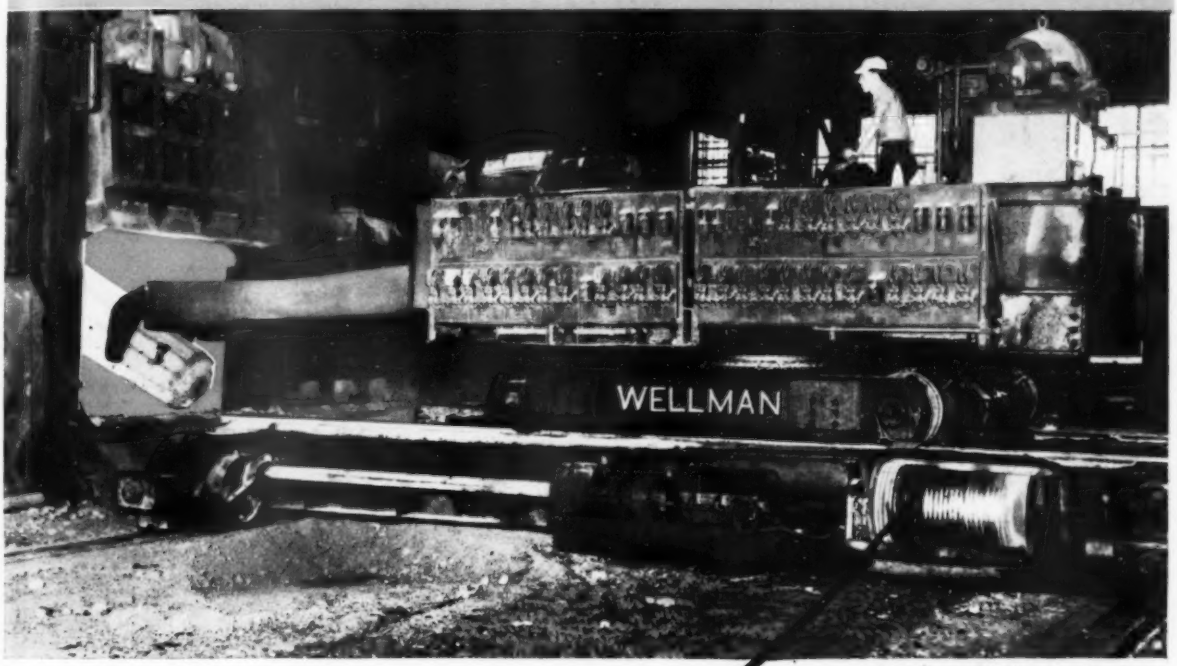

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The G-R Type 1604-B Comparison Bridge is a direct-reading instrument which makes possible the rapid measurement of impedance and dissipation factor of R-L-C components, rheostats, capacitance trimmers and other impedances. Basic measurement accuracy is *one-tenth of one percent* . . . more than required for most measurements.

This Versatile Instrument is Useful for Many Other Types of Work

Checking tracking of condensers and potentiometers to very close tolerances — locating the position at which windings are to be center-tapped — measuring small capacitors in the 1 $\mu\mu$f range — adjusting one component to the value of another, rapidly and reliably

In any laboratory or shop, the Comparison Bridge will prove invaluable for checking, selecting and pairing components within given tolerances – the approach to balance is continuously and instantly indicated.

FEATURES

★ Instrument is completely self-contained and ready for operation — includes internal oscillator, bridge circuit and high-gain non-linear amplifier terminated in a cathode-ray-tube detector.

★ Three Measuring Frequencies — 400 c, 1 kc or 5 kc, selected by panel switch.

★ Two IMPEDANCE DIFFERENCE Dial Ranges — 0 to ±5% range for accurate measurements; 0 to ±20% for determining whether components are within the common 20% tolerances.

★ Accuracy and Range of Impedance Measurements

The range over which the basic ± 01% accuracy applies for resistors, inductors and capacitors is given below. At the more extreme values of impedance, measurements are less accurate.

Frequency	Resistance	Inductance	Capacitance
400 c	2Ω to 20 MΩ	2 mh to 1500 h	100 μf to 50 $\mu\mu$f
1 kc	2Ω to 20 MΩ	1 mh to 250 h	30 μf to 50 $\mu\mu$f
5 kc	4Ω to 2 MΩ	200 μh to 10 h	2 μf to 50 $\mu\mu$f

On the 20% deviation range, accuracy is ±0.5% over the same impedance range.

★ DISSIPATION FACTOR RANGE and Accuracy

Frequency	Range	Accuracy
400 c	±.006	±(0.0002 + 2% impedance diff.)
1 kc	±.015	±(0.0005 + 2% impedance diff.)
5 kc	±.075	±(0.0025 + 2% impedance diff.)

★ CRO visual Detector — horizontal band of light is used as the indicator — highly non-linear detector amplifier keeps indication on scope over wide ranges of unbalance — continual resetting of gain control is eliminated.

★ Zero Adjustment — adjustable index mark on scope can be offset and locked to compensate for deviation of the standard from the desired nominal value — permits use of any component as a standard of comparison.

★ Anyone can be taught to operate the instrument in a very short time.

★ Measurements can be made with unknown grounded or ungrounded, as desired.

★ Dimensions—12" x 14¼" x 10"; Net Weight is 22½ lbs.

1604-B Comparison Bridge $390.00

HIGH-SPEED SORTING with the COMPARISON BRIDGE

Both dials are set to zero, and the cathode-ray-tube adjustable indicator is offset to the desired tolerance to give a visual "go, no-go" indication. As rapidly as each component is plugged into the unknown terminals . . . a few seconds at most . . . the detector indicates whether the unit is acceptable.

GENERAL RADIO Company

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